TABLE OF CONTENTS

PAGE

GETTING STARTED

INTRODUCTION

The Terrace/Diversion Design program is actually a collection of program modules that are accessed through a Main Menu program. Each of the modules is discussed in detail later in this manual. The program is intended to assist engineers and engineering technicians in the design of a terrace or a diversion system.

The terraces or diversions (referred to in this manual as practices) may be designed with underground, grassed waterway, or infiltration outlets. The underground outlet system is designed by the program. Storage pool volumes may be determined by a floodrouting procedure or by volume of runoff procedures. The terrace or diversion system may contain up to 10 practice lines and 10 outlet lines. A maximum of 50 x-sections per practice line with a maximum of 14 points per x-section may be used.

A few of the features worth mentioning here include : the ability to save and recall ground data and design data; the user can create their own default file; moving between screens or directly to a screen is very easy; and the user has control over what reports are printed. There are many other features that are discussed in detail later in this manual.

SYSTEM REQUIREMENTS

In order to run this program, you will need at a minimum the following:

IBM or compatible computer (8088 or above)
Hard disk (with at least 1M of storage space free)
512K bytes of memory (allows for the design of small systems)
(640K is recommended to allow for larger systems)
Graphics adapter and monitor (CGA or equivalent)
DOS 2.0 or higher

Optional items include:

Printer (highly recommended)
If graphics output is desired, you will need an Epson or IBM compatible printer capable of printing graphics.
GRAPHICS.COM (a program which normally comes with DOS), or a similar program to print graphic screen dumps to a printer.
8087 or above math coprocessor

LOADING THE PROGRAM TO THE HARD DISK

An install program is included on Disk Number 1 to assist in installing the program on a hard disk. The steps for using this program are outlined below.

1. Turn computer on and make sure you are at the DOS prompt (e.g., C:\>).

> ***NOTE!!*** The installation program will delete all files from the destination directory before the copying actually begins. If you have files in the destination directory that you want to keep, you should copy them to a floppy or to another directory before performing this installation.

2. Place Disk #1 in drive A.

3. If you are using the Missouri SCS Menu system, you should enter

   A:INSTALL MOSCS

   This will install the programs into the directory C:\ENG\TERRACE and will update the engineering menu.

   If you are not using the Missouri Menu system or you wish to install the programs into a different drive and/or directory, you can enter the following

   A:INSTALL d: mydir

   where **d:** indicates the drive and **mydir** indicates your own directory. You should note that there is a space separating these two options.

4. The install program will then prompt for each disk and will copy the files from each disk. All you need to do is make sure the correct disk is in drive A and press a key when asked.

5. The program will indicate when it is done and will return you to the DOS prompt.

STARTING THE PROGRAM

If the Missouri Menu system is being used, select 5 Engineering Programs to access the Engineering Menu. You should then select number 2 on the Engineering Menu to start the Terrace/Diversion Design program.

If the menu is not being used, the user should access the Terrace/Diversion Design program by entering (each line should be followed with the <*ENTER*> key) the following at the DOS prompt.

d:
CD mydir
TD

where **d:** and **mydir** are the options specified above in the installation section.

PROGRAM CONVENTIONS & ILLUSTRATIONS PROGRAM

KEY CONVENTIONS

This manual denotes a single key as *<key>*, where *key* is the name of the key (e.g., *<F7>* refers to function key 7, located either at the left or the top of the keyboard). Several keys have specific uses in this program. The main keys used and their respective functions are listed below. A list of the applicable keys is listed at the bottom of each screen. If a key varies from its purpose listed here, that will be noted in the appropriate section of the manual.

arrow keys : These are used to move the cursor in the indicated direction.

<Ctrl><End> : If you hold down *<Ctrl>* and then press *<End>*, the program will terminate and you will be returned to the operating system (e.g., DOS).

<Delete> : The delete key is normally used to delete the data in the current field. You might note the warnings in the program sections that follow. Deleting some data fields will clear values elsewhere. This key can also be used while viewing plots in the Print/Plot program to remove the "PRESS ANY KEY TO CONTINUE" message.

<ENTER> : The ENTER key is denoted differently on some keyboards. The key could indicate Enter, carriage return <CR>, or just a symbol like ↵+. This key is used to indicate you are finished entering a value.

<Esc> : The escape key is used to abort the program you are currently in and return to the Main Menu. You will be asked if you really want to quit. If you accidentally pressed the key or you decided you did not want to quit, you would answer N for no. This provides you a way to return to the program. If you had modified any data, you would also be asked if you wish to exit anyway. If you answer Yes, you will lose any data that was modified. If you want to save the data, hit any key besides Y and use *<F10>* to save the data.

<F2> : When you are on a field requesting a filename, you can press *<F2>* to obtain a list of files currently stored on the drive:\path\ specified.

<F3> : This key is used to repeat your last entry. It is most useful right after you enter an existing filename and you wish to use that name as the new filename where data will be stored.

<F4> : In the Design and Change Default Data programs, this key is used to move quickly to another screen. Just enter the number of the screen you wish to see and the program will display that screen.
In the Input Ground Data program, *<F4>* is used to move to the next station and repeat the distance values.

<*F5*> : In the Input Ground Data program, pressing <*F5*> will move to the next station.
It is used in the Design program to move to the next reach, outlet, or cross-section depending on the screen.
The Print/Plot program uses <*F5*> to begin printing and/or plotting.

<*F6*> : In the Input Ground Data program, pressing <*F6*> will move to the previous station.
It is used in the Design program to move to the next reach, outlet, or cross-section depending on the screen.

<*F7*> : Use this key to move to the next pracitce or the next outlet as specified on the current screen.

<*F8*> : Use this key to move to the previous practice or the previous outlet as specified on the current screen.

<*F9*> : In the Input Ground Data program, use this key to delete the data for the current station.
In the Design program, this key is used to change the view on screens 6, 9, and 12. When you press <*F9*>, you are asked for the beginning and ending horizontal values, and the beginning and ending vertical values. Entering these values will define the lower left and upper right corners of the section you wish to view. This section will then be redisplayed to fill the top portion of the screen. Pressing <*Enter*> without entering anything will leave the current value unchanged. If you wish to return to the original view, use <*PgUp*> and then <*PgDn*>.

<*F10*> : Use this key to store your data. When you press <*F10*> in the Input Ground Data or Design programs, the data will be saved in the file defined in the "NEW...FILENAME" field, so be sure to have the filename you want in that field before storing your data. Storing your data intermittently would be advised to avoid data loss due to power interruptions or due to changing or deleting data on one screen that might erase data on succeeding screens (see notes pertaining to this for each screen in the appropriate section). You may also just want to quit and return to this data later.

<*Insert*> : In the Print/Plot program, this key is used to enter an additional note to the plots. See the section on the Print/Plot program for an in-depth explanation of how to use this key.

<*PgDn*> : Use the "page down" key to move to the next screen (e.g., from screen 4 to screen 5).

<*PgUp*> : Use the "page up" key to move to the previous screen (e.g., from screen 3 to screen 2).

<*PrintScreen*> : This key is used to send the current screen to the printer. It may be abbreviated on some keyboards (e.g., PrtSc or PrintScrn). Also, on some keyboards, you will need to use <*Shift*><*PrintScreen*> (i.e., while holding down <*Shift*>, press <*PrintScreen*>). In order to print any screen displayed graphically, the program GRAPHICS should have been executed prior to running the program. If it was not loaded, only the text on the screen will be printed (i.e., none of the drawing).

STATIONING CONVENTION

The stationing conventions used in this program are illustrated below in 1.

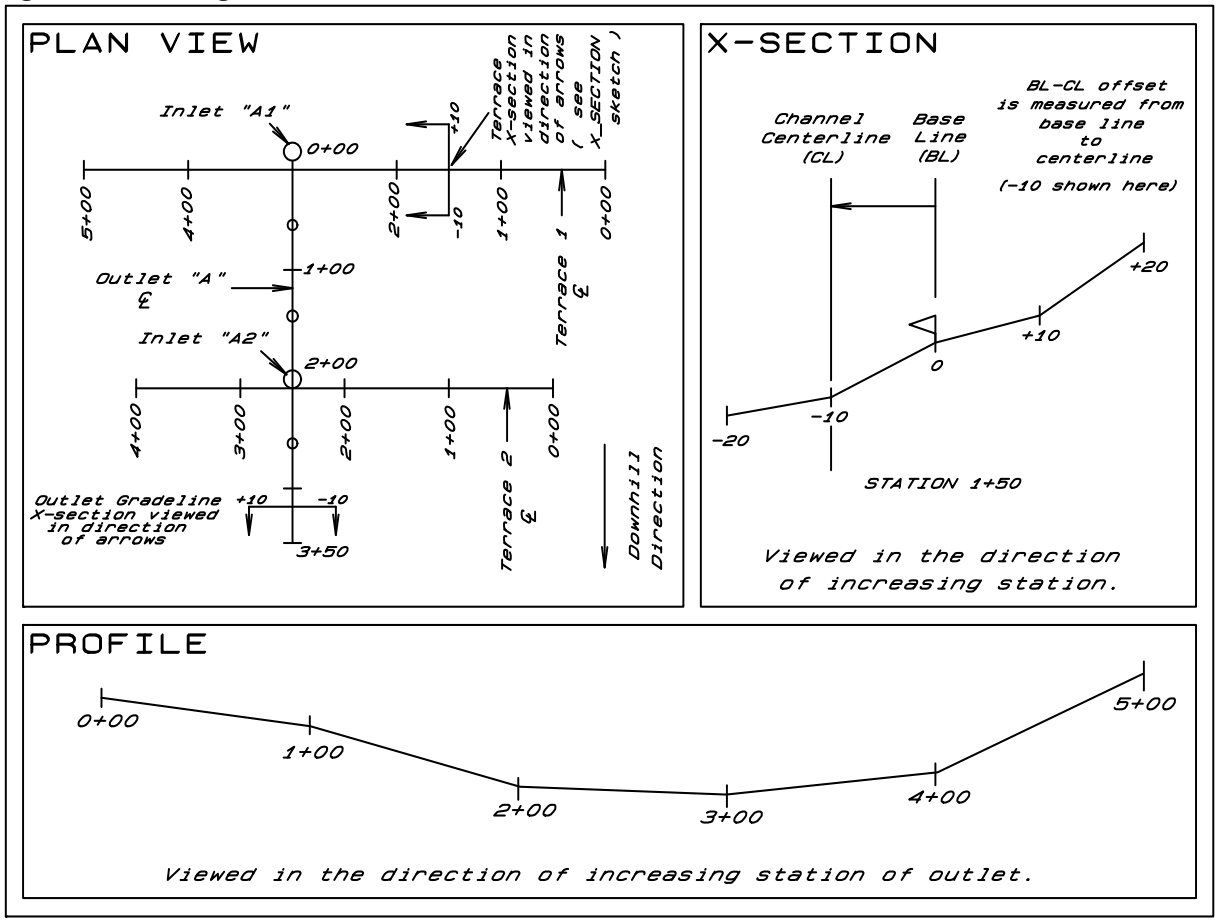
OUTLETS : The profile must have increased stationing going downhill. Outlets are identified by alpha letters (A, B, C, etc.). Cross sections will be viewed in the direction of increasing station (downhill) with positive (+) values to the right and negative (-) values to the left.

PRACTICES : The profile must have stations increase from left to right when looking downhill. Practices are identified by numbers (1, 2, 3, etc.). Cross sections will be viewed in the direction of increasing station with positive (+) values to the right (uphill) and negative (-) values to the left (downhill).

When stations are entered, do not enter the "+" (e.g., station 2+50 should be entered as 250). The "+" is automatically inserted.

The BL-CL offset is the horizontal distance from the baseline (flagline) to the centerline. If (looking in the direction of increasing station) the centerline is to the left of the baseline, the offset used should be negative; otherwise, it will be positive.

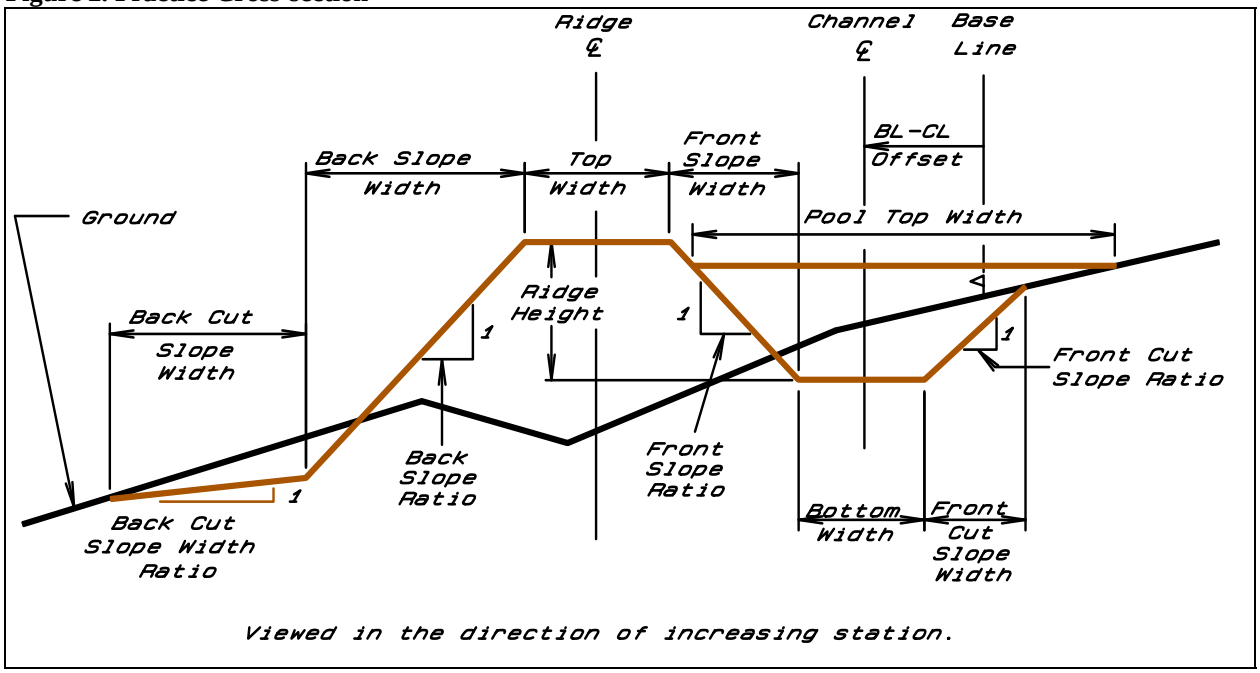
Figure 1. Stationing Convention



PRACTICE X-SECTION ILLUSTRATIONS

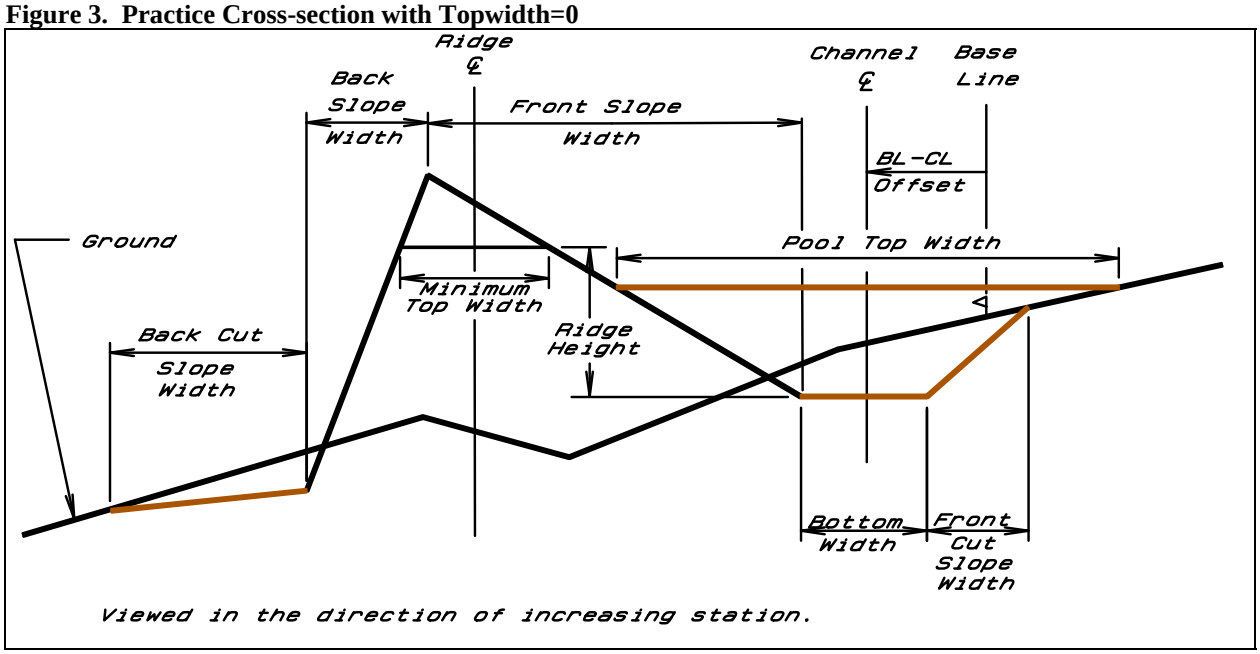
The cross-sectional view shown below in 2 defines most of the dimensions used by the program. You should note that the ridge centerline is the center of the topwidth; the ridge height is measured from the channel bottom to the top of the terrace; and the front slope width is measured between the two points shown.

Figure 2. Practice Cross-section



3 shows a similar cross-section except the top width equals 0. With this condition, the ridge centerline is determined by the center of a line where the minimum top width would occur; the ridge height is measured between this same line and the channel bottom; and the front slope width is measured from the channel bottom to the peak of the ridge as shown. A similar situation could occur when the channel bottom width is 0. In that case, the channel centerline is determined by the center of a line where the minimum bottom width would occur; the ridge height is measured between this same line and the top of the terrace; and the front slope width is measured from the top of the terrace to the valley of the channel.

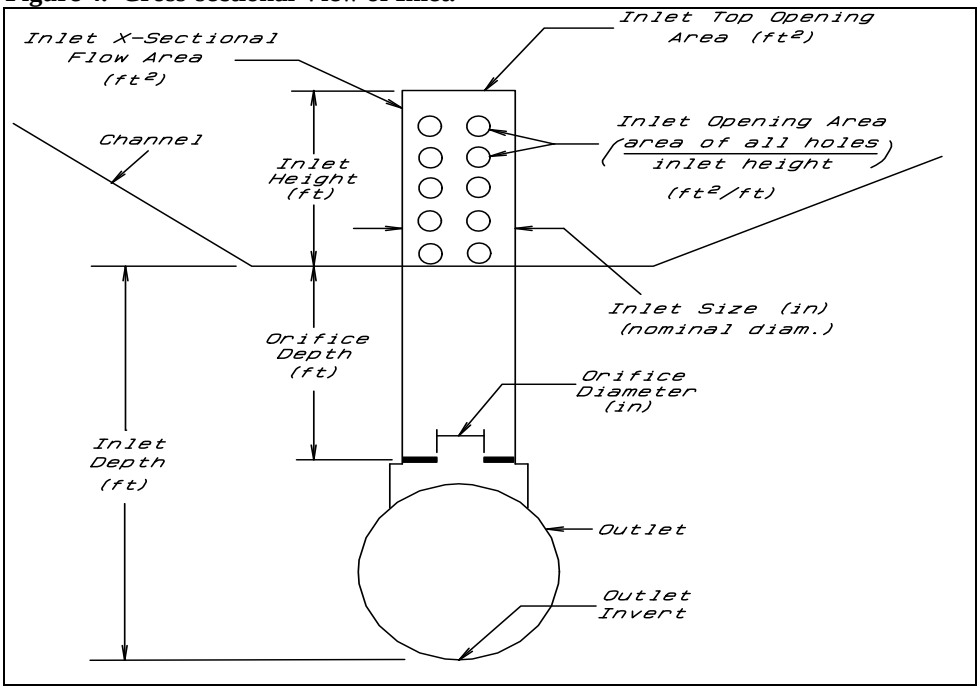
Figure 3. Practice Cross-section with Topwidth=0



INLET ILLUSTRATION

4 below describes the dimensions related to the inlet. The orifice is optional.

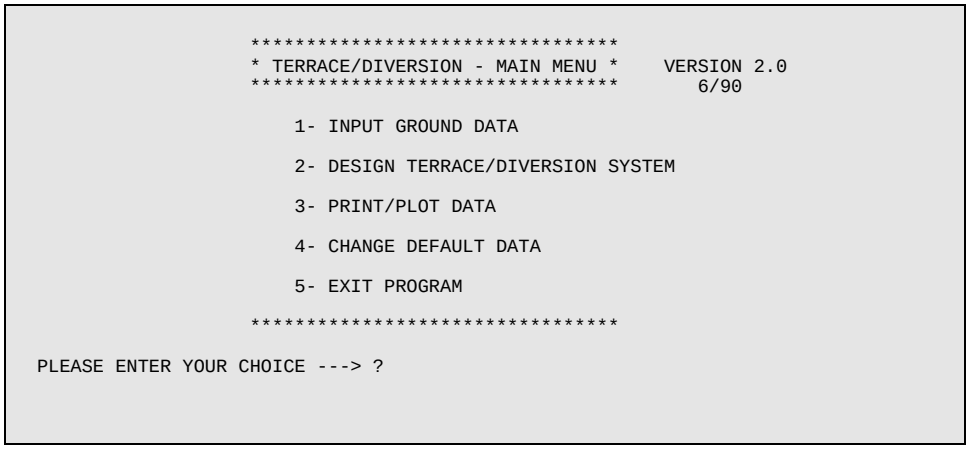
Figure 4. Cross-sectional View of Inlet.



MAIN MENU

This screen displays the Main Menu. Its only purpose is to transfer control to one of the program modules.

MAIN MENU



1 - Input Ground Data : This program allows you to enter the survey data collected from the field. This includes the ground data for the ridge and channel as well as any outlets there may be.

2 - Design Terrace/Diversion System : This program allows you to design a system using the ground data entered above. Other specifications are needed, such as watershed information, outlet type and location, cross section shapes, etc., in order to arrive at a final design.

3 - Print/Plot Data : Using this program, you can obtain a hardcopy of ground data entered in the Input Ground Data program and various details of the design derived in the Design program. This includes plotted, or graphical, output (if your printer is Epson compatible) as well as text output.

4 - Change Default Data : You can set your own defaults, such as user ID, conduit types and values, various design criteria, type of reports, etc.

To select the desired program, enter the appropriate number. These programs will be discussed in more detail in the following sections. To return to this menu from any of the above programs, press <*Esc*>. Returning to this menu will lose any data you have entered, unless you store it before exiting the program you are running.

INPUT GROUND DATA MODULE

This program allows you to enter or edit the ground data for the channel and/or outlet.

DATA CAN BE STORED AT ANYTIME BY PRESSING <*F10*> !
Storing your data intermittently would be advised to avoid data loss due to power interruptions or due to changing or deleting data on one screen that might erase data on succeeding screens (see notes pertaining to this for each screen below). For more information on <*F10*>, see the section on key conventions (page 3).

SCREEN 1 - Ground Data Filename Input

The screen below is the first screen of the ground survey data input module. It is where the filename information is entered. When you first enter this screen, the cursor will be placed on the EXISTING GROUND DATA FILENAME field.

SCREEN 1

```
GROUND DATA FILENAME INPUT                  SCREEN 1

     DRIVE:\PATH\ WHERE DATA IS LOCATED --->  A:
                        DATA TYPE CODE --->   1
          EXISTING GROUND DATA FILENAME --->  SAMPLE
               NEW GROUND DATA FILENAME --->  SAMPLE
                         LANDOWNER NAME --->  JOHN SMITH
                               TOWNSHIP --->  26N
                                  RANGE --->  31W
                                SECTION --->  12
                               FIELD NO.--->  10
A:\
SAMPLE  .GRD
 343040 Bytes free


                               DATA TYPE CODES
   1 - TERRACE/DIVERSION  RIDGE & CHANNEL      2 - TERRACE/DIVERSION  OUTLET

 Esc-MAIN MENU  F2-LIST FILES  Pg Dn-NEXT SCREEN  F3-REPEAT  F10-STORE DATA
```

DRIVE:\PATH\ WHERE DATA IS LOCATED : This value indicates where your data is stored (e.g., A:\ or C:\TERDATA\ ). It is retrieved from the default file, but can be changed at this time. If it is left blank, the current drive and directory will be used (normally, the same place the program is stored).

DATA TYPE CODE : This code must be entered to indicate the type of ground data this will be, either 1 for ridge and channel or 2 for outlet. Valid values are shown near the bottom of the screen. It will contain 1 as a default.

> ***NOTE!!*** Pressing <*Delete*>, when the cursor is located at Existing Ground Data Filename, will clear all existing profile/cross-section data. The vertical control data is retained.

EXISTING GROUND DATA FILENAME : An entry here will bring in existing data (previously entered and stored with this program) which may be reviewed and edited or appended. The filename should be limited to 8 characters. The extension of ".GRD" (for ridge and channel data), ".OGD" (for outlet ground data), or ".VCD" (for vertical control data) is automatically added to this name. Pressing <*F2*> while on this field will list all of the existing ground data files in the middle section of the screen (e.g., SAMPLE.GRD in the screen shown above) and the amount of storage space left on the disk (e.g., 343040 bytes free). If this is new ground data, skip this field.

NEW GROUND DATA FILENAME : The name of an existing file or a new file where the data will be stored (i.e., when the <*F10*> key is pushed). If the file already exists, it will be overwritten. Ground data is automatically given a file extension of ".GRD", ".OGD", or ".VCD" (as noted above). Often the user will want to use the same file names in the two information fields of "EXISTING..." to retrieve the data and "NEW..." to store the data back to the same file. Use <*F3*> here to quickly enter the same name as in the "EXISTING ..." field.

> ***NOTE!!*** If the same NEW GROUND DATA FILENAME is used for data type 1 (ridge and channel ground) and data type 2 (outlet ground), the vertical control data file will contain the vertical control data present when the last save was performed. If you want a separate vertical control data file for each type of data, you will need to use different NEW GROUND DATA FILENAMES.

LANDOWNER NAME, TOWNSHIP, RANGE, SECTION, and FIELD NO. : These fields are used for identification purposes only. Enter the appropriate information in each field. This information is stored in the vertical control data file.

SCREEN 2 - Vertical Control Data

The Vertical Control Data Screen allows you to enter survey notes as you would normally enter them in a field book. The cursor will automatically move to the next logical input field as you are entering data.

SCREEN 2

```
PAGE 1                    VERTICAL CONTROL DATA                    SCREEN 2
-------------------------------------------------------------------------------
 STA. : B.S.  : H.I.  : F.S.  : ELEV. :   Bench Mark Descriptions & Notes
------:-------:-------:-------:-------:-------------------------------------
TBM#1 :2.31   : 102.31:       :100.0  : Top of lower gate hinge pin in
      :       :       :       :       : sw corner of field 10
TP#1  :2.11   : 97.69 :6.73   : 95.58 :
      :       :       :       :       :
HUB#1 :2.01   : 94.06 :5.64   : 92.05 : LAYOUT HUB FOR TERRACE #1 @ STA 4+50
      :       :       :       :       :
HUB#2 :2.34   : 86.06 :10.34  : 83.72 : LAYOUT HUB FOR TERRACE #2 @ STA 6+00
      :       :       :       :       :
HUB#3 :14.56  : 89.49 :11.13  : 74.93 : LAYOUT HUB FOR TERRACE #3 @ STA 6+00
      :       :       :       :       :
TP#2  :15.67  : 103.11:2.05   : 87.44 :
      :       :       :       :       :
TBM#1 :       :       :3.08   : 100.03: CLOSURE ERROR = 0.03 FT
      :       :       :       :       :
      :       :       :       :       :
      :       :       :       :       :
-------------------------------------------------------------------------------

       Esc - MAIN MENU      Pg Dn - NEXT SCREEN      Pg Up - PREV. SCREEN
    F3 - REPEAT ENTRY   F7 - NEXT PAGE   F8 - PREV. PAGE    F10 - STORE DATA
```

STA. : This column indicates benchmarks, stations, turning points, etc. Station numbers are entered without the "+" (e.g., station 1+00 should be entered as 100). The "+" is automatically inserted.

B.S. : Enter backsights in this column.

H.I. : The height of instrument is calculated as backsights and foresights are entered. If an entry (e.g., B.S. or F.S.) is changed, all H.I.'s for that page only are recalculated. To update the H.I. on any succeeding pages, you would have to go to that page and reenter the first H.I. The last H.I. on a page will be carried over to the next page when <*F7*> is pressed and there is no H.I. on the next page. The last H.I. on the current page will be carried over to the cross-section screen (screen 3) if the H.I. field on that screen is left blank. To fully utilize this feature, you should enter the vertical control data down to the point you obtain an H.I. that was used to survey the x-sections (e.g., HUB#1 in the screen above). You can then press <*PgDn*> to go to the x-section screen and enter the x-sections for this H.I. Press <*PgUp*> to return to vertical control data screen and repeat the process for next H.I.

F.S. : Enter foresights in this column.

ELEV. : The elevation is calculated as backsights and foresights are entered. If an entry is changed, all elevations on the current page are recalculated.

Benchmark Descriptions & Notes : You can enter any notes or comments in this column. This column has a wrap feature. If you reach the end of the input field it will automatically continue to the next note line (i.e., you do not have to press <*ENTER*>).

Lines can be left blank if you would like to space out the entries. Five pages of data are available. Just use <*F7*> to page forward or <*F8*> to page back. **NOTE:** It would be advisable to start a new page if you start a new circuit.

arrow keys : Move from column to column in direction of arrow key.

<*Home*> : Move to B.S. column.

<*End*> : Move to Notes column.

<Delete> : **USE WITH CAUTION!** If the cursor is in the notes column, all of the notes from the current line to the end (i.e., current page and succeeding pages) will be deleted. If the cursor is in any other column, all of the data (excluding notes) from the current line to the end will be deleted.

SCREEN 3 - Ground Profile/X-Section Data

Upon entering the Ground Profile/X-Section Data screen, the cursor is placed on the ELEV or F.S. line for existing data or the DIST line for new data. To change STATION, STA INCR, H.I., or % GRD SLOPE, press the up arrow until cursor moves to that line and then the left or right arrow key to move to appropriate field. You will need to press the down arrow to return to the point data.

SCREEN 3

```
GROUND PROFILE/X-SECTION DATA                SCREEN 3

        TER/DIV NO.   1                X-SECTION NO.  1   OF  10

  STATION =  0+00   STA INCR =  50     H.I. =  100    % GRD SLOPE =

F.S.     5        3.2
----    -----    -----    -----    -----    -----    -----    -----
DIST     0        30

                          POINT NUMBER  1  OF  2




    F4-NEXT STA./REPEAT DIST.   F5-NEXT STATION       F6-PREVIOUS STATION

    F7-NEXT TER/DIV             F8-PREV TER/DIV       F9-DELETE STATION

    Del-DELETE POINT            Home-START OF X-SEC   End-END OF X-SEC

   Esc-MAIN MENU      Pg Up-PREV. SCREEN       F3-REPEAT      F10-STORE DATA
```

TER/DIV NO. or **OUTLET** : This number or letter indicates either the current practice or the current outlet you are working on. Press *<F7>* to go to the next one or *<F8>* to go to previous one. Maximum value is set in the Change Default Data program (screen 11).

X-SECTION NO. __ OF __ : The first number represents the x-section number you are working on. The second number represents the number of sections saved in memory for this practice or outlet. On the screen above, you would be on the first x-section of 10. Press *<F4>* to move to the next station and repeat your distance values, or *<F5>* to move to the next station, or *<F6>* to move to the previous station. The maximum number of x-sections per line is set in the Change Default Data program (screen 11).

STATION = : This value indicates the current station. You can change the value here by entering a new value or use *<F4>*, *<F5>*, or *<F6>* to move between the stations. You cannot enter a station that already has been entered. The above sample shows that you are positioned at station 0+00.

NOTE!! If *<F10>* is pressed to store the data, the stations are sorted and placed in ascending order and the current station is kept on the same x-section no., which may result in different x-section data appearing on the screen.

STA INCR : This value determines what the next station will be if you are at the last station and press <*F4*> or <*F5*>. The above example shows that 50 will be added to the last station. For example, if the last station is 5+00, the next station added will be 5+50. You can change the value here by entering a new value.

H.I. : If a value for height of instrument is entered, then the program assumes foresights are being entered and the input line of **ELEV** is changed to **F.S.** If it is left blank, the current H.I. from Screen 2 will be used. It may be changed whenever desired. If you return to Screen 2 for entry of more survey data and want to return with new H.I., delete the existing H.I. on this screen first.

ELEV or **F.S.** : Data input line for elevations or foresights. The example shows two points with foresights of 5 and 3.2.

DIST : Distance input line. Distance is measured from the baseline (see the cross-section definition in 1 on page 5). The points need not be entered in any order, they will be sorted automatically. You cannot enter two points with the same distance. The example has two points with distances of 0 (on the baseline) and 30.

POINT NUMBER __ OF __ : The first number represents the point you are working on. The second number represents the number of points entered for this x-section. The maximum number of ground points allowed is set in the Change Default Data program (screen 11). Only 7 are displayed on the screen at one time. As you enter more than 7 values, they are scrolled horizontally. Press <*Home*> to move to the first point or <*End*> to move to the last point.

Entry of only one ground point is allowed. If the point is located on the practice centerline, it will be used in plotting the existing ground profile. One point data will not be used in the earthwork calculations. See 1 on page 5 for station and distance conventions.

The screen sample above shows a two point X-SECTION @ STA 0+00 entered with foresights and elevations calculated from an H.I. of 100.

<*F9*> : <*F9*> may be used to delete the information of the station which is currently shown on the screen.

<*Delete*> : The delete key may be used to delete the point (ELEV and DIST) at the cursor. At least one point must remain in a x-section. The last point may not be deleted.

DESIGN TERRACE/DIVERSION SYSTEM MODULE DESIGN

This program is used with the ground data which was entered through the INPUT GROUND DATA program to allow the user to specify the criteria needed to design a terrace or diversion system. The values needed are described below in the description of the screens. For technical background on how any value is calculated, refer to Appendix 0 - Technical Information (page 81).

DATA CAN BE STORED AT ANYTIME BY PRESSING <*F10*> !

Storing your data intermittently would be advised to avoid data loss due to power interruptions or due to changing or deleting data on one screen that might erase data on succeeding screens (see notes pertaining to this for each screen below). For more information on <*F10*>, see the section on key conventions (page 3).

SCREEN 1 - Design File Information

The screen below is the first screen of the design terrace/diversion system module. It is where the filename information is entered.

SCREEN 1

```
TERRACE / DIVERSION  DESIGN                SCREEN 1

                              FILE INFORMATION

     DRIVE:\PATH\ WHERE DATA IS LOCATED --->  A:\
              EXISTING TER/DIV FILENAME --->  SAMPLE
                   NEW TER/DIV FILENAME --->  SAMPLE
                TER/DIV GROUND FILENAME --->  SAMPLE
                 OUTLET GROUND FILENAME --->  SAMPLE
                               DESIGNER --->  TOM KEEP        DATE 05-01-1990









            Esc-MAIN MENU           Pg Dn-NEXT SCREEN
     F2-LIST FILES    F3-REPEAT ENTRY    F4-GO SCREEN    F10-SAVE DATA
```

DRIVE:\PATH\ WHERE DATA IS LOCATED : This value indicates where your data is stored (e.g., A:\ or C:\TERDATA\ ). It is retrieved from the default file, but can be changed at this time. If it is left blank, the current drive and directory will be used (normally, the same place the program is stored).

> ***NOTE!!*** When new information is entered into any of the filename fields (except NEW TER/DIV FILENAME), any current design and ground data information in memory is erased. Pressing <*Delete*> will also do the same as well as clear out the current entry to make way for any new information.

EXISTING TER/DIV FILENAME : The name of a file that contains data from a previously created practice design (one that has been previously stored using this program). The filename should be limited to 8 characters. The extension of ".DES" is automatically added to the name. If this is a new design, skip this field.

NEW TER/DIV FILENAME : The name of an existing file or a new file where the data will be stored (i.e., when the <*F10*> key is pushed). If the file already exists it will be overwritten. Often the user will want to use the same file names in the two information fields of "EXISTING ..." to retrieve the data and "NEW ..." to store the data back to the same file. Use <*F3*> here to quickly enter the same name as in the "EXISTING ..." field.

TER/DIV GROUND FILENAME : The name of a file that contains previously stored ridge and channel ground data from the Input Ground Data program. If you entered information into the "EXISTING ..." field, this field will be automatically filled in with the corresponding filename and you cannot change it. This data is required for a design.

OUTLET GROUND FILENAME : The name of a file that contains previously stored outlet ground data from the Input Ground Data program. If you entered information into the "EXISTING ..." field, this field will be automatically filled in with the corresponding filename and you cannot change it. This data is optional for a design.

DESIGNER : This field is used for identification purposes. If you are doing the design, enter your name.

DATE : This is the computer's current date for a new design or the date the design was last saved for an existing design.

SCREEN 2 - Watershed Information

The Watershed Information screen, shown below, is used to enter information for up to 10 reaches for each practice line and to calculate watershed and runoff depth for each reach. Each value is described in detail below. The example below shows 3 reaches for terrace 2.

SCREEN 2

```
TERRACE/DIVERSION  WATERSHED INFORMATION        SCREEN 2

    TER/DIV NO. 2        DESIGN STORM FREQ. 10    RAINFALL DEPTH (IN) 5

  FROM     TO      AVE.     WSHED      AVE.    SOILLOSS   RUNOFF    RUNOFF
  STA.     STA.   WIDTH FT  AREA AC   SLOPE %   TONS/AC   CURVE NO  DEPTH IN

  0+00    5+00      120      1.38      6         5           75      2.45
  5+00   10+00      150      1.72      4         5           75      2.45
 10+00   15+00      120      1.38      4         5           75      2.45









     Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT TER/DIV     F8-PREV TER/DIV     F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screen 3 on. This is done to prevent an incorrect design from being performed.

TER/DIV NO. : This number (2 in the screen above) indicates the current practice you are working on. Press *<F7>* to go to the next one or *<F8>* to go to previous one. Maximum value is set in the Change Default Data program (screen 11).

DESIGN STORM FREQ. and
RAINFALL DEPTH, (IN) : These values are read in from the default file and you cannot change them here. To change them, use the Change Default Data program (screen 6).

FROM STA. : The "From Station" indicates the start of each reach. It cannot be edited. It starts with the first reach on the practice. When more than one reach exists, it contains the "To Station" value of the previous reach.

TO STA. : The "To Station" indicates the end of each reach. It cannot be greater than the last station on the practice. When you enter a value less than the last station, this value is used as the beginning of the next reach (i.e., a new line of input is created). Station numbers are entered without the "+" (e.g., station 1+00 should be entered as 100). The "+" is automatically inserted.

AVE. WIDTH, FT. : Enter the average width of the watershed (e.g., terrace spacing) in feet for each reach.

WSHED AREA, AC. : The watershed area, in acres, is calculated from the distance between stations and the average width entered. If this does not represent the correct watershed area, you may change this value by entering the correct watershed area measured from a map or calculated by other means.

AVE. SLOPE % : Enter the average watershed slope in percent.

SOIL LOSS, TONS/AC : Enter the soil loss in tons per acre.

RUNOFF CURVE NO. : Enter the runoff curve number, which indicates the runoff potential for a given combination of hydraulic soil group and land cover. This number must fall in a range determined by rainfall.

RUNOFF DEPTH, IN. : This value is calculated and cannot be edited.

SCREEN 3 - Outlet Location Information

The outlet locations are defined using the screen below.

SCREEN 3

```
TERRACE/DIVERSION  OUTLET LOCATION INFORMATION      SCREEN 3

    TER/DIV NO. 2

 FROM     TO    OUTLET    PRACT   OUTLET   OUTLET   OUTLET    WSHED   RUNOFF
 STA.    STA.     ID      STA.     STA.     ELEV.   C/F FT   AREA AC  VOL ACF

  0+00   10+00     A       6+00     1+50     82               3.1      .63
 10+00   15+00     B      13+00     0+00     82      -1       1.38     .28

     Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT TER/DIV     F8-PREV TER/DIV     F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screen 4 on. This is to prevent an incorrect design from being performed.

TER/DIV NO. : This number indicates the current practice you are working on. Press *<F7>* to go to the next one or *<F8>* to go to the previous one.

FROM STA. : The "From Station" indicates the start of each reach, which drains to outlet. It cannot be edited. It starts with the first reach on the practice. When more than one reach exists, it contains the "To Station" value of the previous reach.

TO STA. : The "To Station" indicates the end of each reach, which drains to outlet. It cannot be greater than the last station on the practice. When you enter a value less than the last station, this value is used as the beginning of the next reach (i.e., a new line of input is created).

OUTLET ID : This must be a letter (e.g., A, B, C, etc.). The maximum number of outlets is defined in the Change Default Data program (screen 11).

PRACT STA. : Enter the station along the practice line where the outlet occurs.

OUTLET STA. : Enter the station along the outlet line where the outlet intersects the practice.

OUTLET ELEV. : This should be the elevation of a planned UGO inlet, waterway gradeline intersection, or infiltration basin. The outlet elevation is calculated from the ground at the channel centerline if an "Outlet C/F" value is entered.

OUTLET C/F, FT. : This value indicates the outlet cut/fill from the channel centerline. Cut values should be negative and fill values positive. It is calculated if the outlet elevation was entered.

WSHED AREA, AC : The watershed area in acres is calculated by overlaying the watershed reaches defined on screen 2 over the outlet reaches defined here. This field cannot be changed.

RUNOFF VOL, ACF : The runoff volume in acre feet is computed by overlaying the watershed reaches defined on screen 2 over the outlet reaches defined here. This field cannot be changed.

SCREEN 4 - Outlet Type, End, & Junction Information

Screen 4, shown below with two outlets, deals with defining the type of outlets, the end of each outlet, and any outlet junctions there may be. If the outlet type is an infiltration basin or a structure, most of the columns will not apply and will show an NA to indicate such.

SCREEN 4

```
OUTLET TYPE, END, & JUNCTION  INFORMATION          SCREEN 4

  OUTLET    OUTLET     END       END       T.W.      JCT.      JCT.     WSHED
    ID       TYPE      STA.      ELEV.     ELEV.      ID       STA.      AREA

    A          1       4+60      62.5      66                            9.98
    B          2       3+60      60.5                                    3.45









                              OUTLET TYPE CODES
 1-UNDERGROUND OUTLET    2-GRASSED WATERWAY    3-INFILTRATION    4-STRUCTURE

       Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
                        F4-GO SCREEN          F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screens 5-7 and 10-11.

OUTLET ID : This indicates which outlet you are designing. You cannot edit this value, since it is retrieved from screen 3.

OUTLET TYPE : The code determining the outlet type should be entered here. The valid choices are 1-underground outlet, 2-grassed waterways, 3-infiltration, or 4-structure. These choices are listed near the bottom of the screen. A practice can have more than one outlet type (e.g., an underground outlet on one reach and a waterway on another reach).

END STA. : This is the station at the end of the outlet.

END ELEV. : This is the elevation at the end of the outlet.

T.W. ELEV. : Enter the elevation of any tailwater that may exist. Leave blank if there is no tailwater.

JCT. ID : If there was an outlet junction, this letter indicates the ID of the outlet to which this outlet joins. The information for the outlet you are joining must be entered before you can enter the ID here. You are not allowed to join different types of outlets, an outlet to itself, or an outlet to another outlet that is currently joined to the current outlet (forming a closed loop).

JCT. STA. : This indicates the station along the outlet joined. A JCT ID must be input prior to entering this value.

WSHED AREA : The total watershed area (acres) at the end of the outlet is displayed here. This does not include any junctions. You cannot change this value here.

SCREEN 5 - Inlet Information

The inlet information screen shown below allows you to specify the inlet type, size, and depth as well as orifice information for each inlet. A cross-sectional view of an inlet for an underground outlet (UGO) is shown in 4. The defaults for these can be set in the Change Default Data program (screen 13). This screen is used only for an underground outlet. None of the data applies for grassed waterways, infiltration basins or structures as indicated by NA in all of the columns.

SCREEN 5

```
INLET  INFORMATION                    SCREEN 5

       OUTLET  A

  OUTLET    INLET     INLET     INLET       INLET      ORIFICE     ORIFICE
   STA       ID       TYPE      SIZE       DEPTH-FT    DEPTH-FT     DIA-IN

   0+00      A1         1         6          3
   1+50      A2         1         10         3
   3+00      A3         1         12         3




                              UGO INLET TYPE CODES
   1 = MO-I          2 = MO-II         3 = NEBR          4 =

      Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
   F4-GO SCREEN     F7-NEXT OUTLET     F8-PREV OUTLET     F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screens 6,7, and 11.

OUTLET : This letter indicates the current outlet you are working on (A in the example above). Press <*F7*> to go to the next one or <*F8*> to go to the previous one.

OUTLET STA. : Outlet station is retrieved from screen 3. It indicates where along the outlet line that the inlet occurs. You cannot edit this field.

INLET ID : The first character of the ID (a letter) denotes the outlet ID and the second character (a number) denotes the practice number. This is summarized from screen 3 and you cannot change it.

INLET TYPE : This column is used primarily for UGOs to indicate the type of inlet. The available choices (shown near the bottom of the screen) are the types entered in the Change Default Data program (screen 8). The above example shows these to be 1 = MO-I (Missouri Type I), 2 = MO-II (Missouri Type II), or 3 = NEBR (Nebraska). If the outlet is not an UGO, the following are displayed here: WW for grassed waterway, INFL for infiltration basin, or STR for a structure and they cannot be changed.

INLET SIZE : You can enter a size here in inches or use the default value (see screen 13 in the Change Default Data program). Inlet size required is calculated at a later time. If the size you enter here is less than the required size, the required size will replace your value; otherwise, your value is used.

INLET DEPTH-FT : This is the vertical distance from the ground to the outlet invert (flow line).

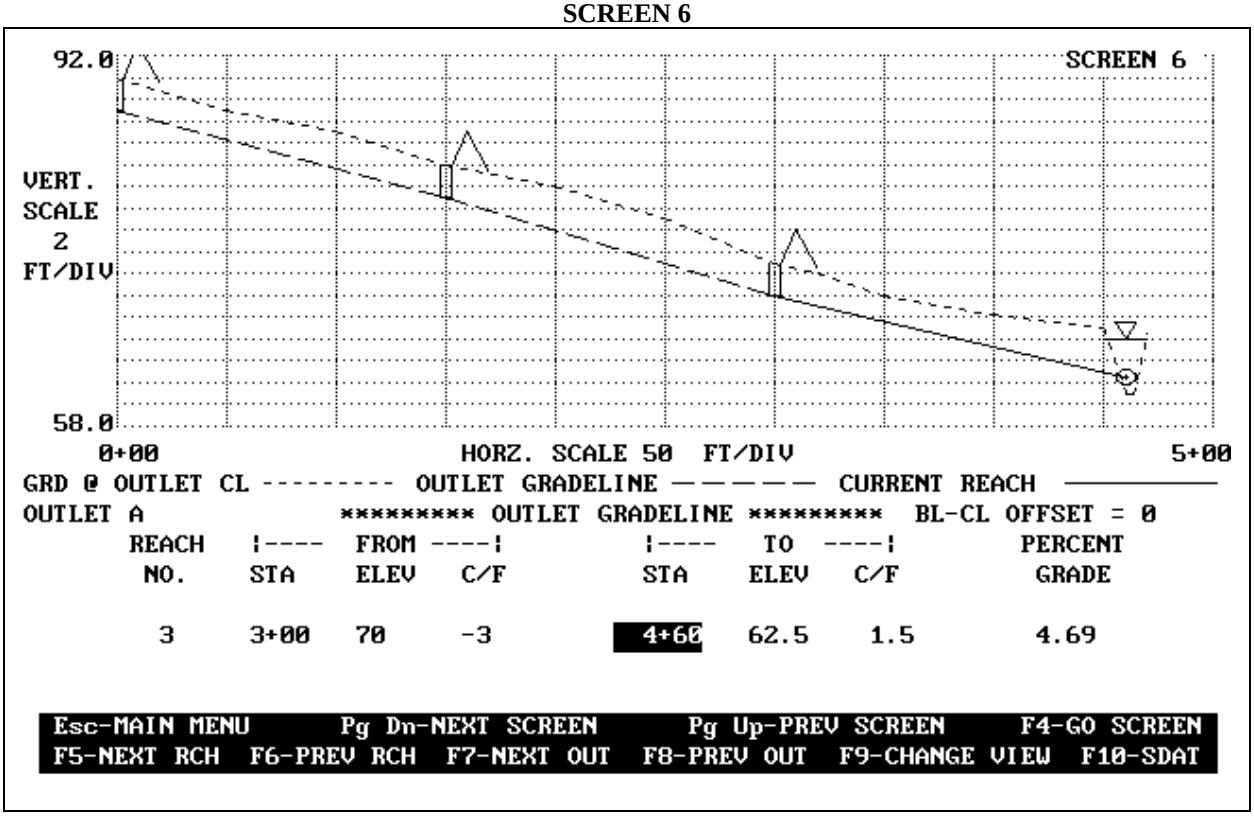
ORIFICE DEPTH-FT : If an orifice depth (vertical distance, in feet, from the ground to an orifice) is entered, it is assumed that the orifice will control flow.

ORIFICE DIA-IN : You cannot edit the orifice diameter. It will be computed to the nearest 0.25 inches when the practice storage pool is designed on screen 11.

SCREEN 6 - Outlet Gradeline

Screen 6, shown below, is used to define the outlet gradeline for UGOs and waterways. No gradeline is required for infiltration basins and structures. The top portion of the screen displays a profile of the ground (short dashed line) and the outlet gradeline (long dashed line) along the outlet centerline. The location of any ridge, inlet, outlet, and tailwater is also indicated in this view with graphical symbols. The lower part of the screen displays the beginning and ending station information for a particular reach. This information is described below. When entering this screen, the horizontal and vertical scales are automatically adjusted in order to fill the screen. See *<F9>* below to change the horizontal and vertical scales.

SCREEN 6



NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screens 7 and 11.

OUTLET : This letter indicates the current outlet you are working on (A in the example above). Press <*F7*> to go to the next one or <*F8*> to go to the previous one.

REACH NO. : This value indicates the current reach you are working on (3 in the example above). The current reach is also indicated in the view by a solid line. Press <*F5*> to move to next reach or <*F6*> to move to the previous one. The gradeline may be entered automatically from inlet to inlet by pressing <*F5*>. The maximum number is 12.

FROM STA : The beginning station of the current reach is shown here. It is either the beginning of the first reach or the end of the previous reach. You cannot edit this value.

FROM ELEV : You can enter the elevation of the outlet gradeline at the start of the current reach. If a value is entered here, then the "FROM C/F" (see below) is calculated. If no value is entered, then "FROM C/F" or the "PERCENT GRADE" should be entered.

FROM C/F : You can enter the amount of cut (negative number) or fill (positive) for the gradeline at the beginning of this reach. If a cut/fill value is entered, the elevation is calculated.

TO STA : Enter the ending station of the current reach. If the value input here is less than the last station, a new reach will be added at the end with the "FROM STA" being the value entered here. You cannot enter a value greater than the last station.

TO ELEV : You can enter the elevation of the outlet gradeline at the end of the current reach. If a value is entered here, then the "TO C/F" (see below) is calculated. If no value is entered, then "TO C/F" or the "PERCENT GRADE" should be entered.

TO C/F : You can enter the amount of cut (negative number) or fill (positive) for the gradeline at the end of this reach. If a cut/fill value is entered, the elevation is calculated.

PERCENT GRADE : You can enter a percent grade and let the program determine the elevation and cut/fill values for the end of the reach.

<F9> : Use to change the screen view of the gradeline. When you press *<F9>*, you are asked for the "FROM STA", the "TO STA", the "FROM ELEV", and the "TO ELEV". Entering these values will define the lower left and upper right corners of the section you wish to view. This section will then be redisplayed to fill the top portion of the screen. Pressing *<Enter>* without entering anything will leave the current value unchanged. If you wish to return to the original view, use either *<PgUp>* and then *<PgDn>* or *<F7>* and then *<F8>*.

SCREEN 7 - Outlet Design Information

The outlet design information screen, shown below, is used primarily to define conduit type and size for UGOs. If the outlet is a waterway, most of the columns will show NA (for Not Applicable). For an infiltration basin or structure, you will receive the message "No Outlet Design Required".

SCREEN 7

```
OUTLET  DESIGN  INFORMATION              SCREEN 7

       OUTLET A

  FROM     TO     ACCUM    INFLOW    INFLOW   COND  REL.  COND   REQD    COND
  STA     STA      DA      POINT     CONTROL  TYPE  TIME  SIZE   CFS     CAP

  0+00    1+50     3.44   INLT A1   CONDUIT    2     28.2  4     .356    .356
  1+50    3+00     6.54   INLT A2   CONDUIT    2     10.8  6    1.064   1.064
  3+00    4+60     9.98   INLT A3   CONDUIT    2     9.3   8    2.138   2.138









                            CONDUIT TYPE CODES
 1 = PCPT     2 = CPT      3 = TILE     4 = PVC      5 = CMP      6 =

     Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT OUTLET      F8-PREV OUTLET      F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screen 11.

OUTLET : This letter indicates the current outlet you are working on (A in the example above). Press *<F7>* to go to the next one or *<F8>* to go to the previous one.

FROM STA. : The beginning station of each reach is retrieved from previous screens and cannot be changed here.

TO STA. : The ending station of each reach is retrieved from previous screens and cannot be changed here.

ACCUM DA : This column displays the accumulated drainage area, in acres, calculated for this outlet.
INFLOW POINT : This column will display "NONE" (for no inlet or outlet junction); will show an inlet (e.g.,

INLT A1); or will show an outlet junction (e.g., JT AB, which would indicate a junction of outlets A and B).

INFLOW CONTROL : Either CONDUIT or ORIFICE will be displayed in this column to indicate what controls the flow.

COND TYPE : Specify the type of conduit by entering a number from 1 to 6 or leaving the default value which can be changed in the Change Default Data program (screen 13). The available types are shown near the bottom of the screen. These types can be modified in the Change Default Data program (screen 2). In the example above, the types are 1 = PCPT (perforated corrugated polyetylene), 2 = CPT (corrugated polyetylene tubing), 3 = TILE (clay or concrete tile), 4 = PVC (polyvinyl chloride pipe), 5 = CMP (corrugated metal pipe), and 6 = blank.

REL. TIME or
COND SIZE : Enter either the release time in hours or the conduit size in inches. These can only be entered for reaches with inlets. The values for all downstream reaches are calculated when a value is entered (see the procedures section in Appendix 0).

REQD CFS and
COND CAP : The required flow and the conduit capacity, both in cfs, are calculated by the program. If conduit controls the flow, the two values will be the same. If inlet controls the flow, the values may be different. Refer to the procedures section in Appendix 0 for methods of calculation.

SCREEN 8 - X-Section Information

The screen shown below allows you to define up to five different x-section templates per practice to be placed over the ground data. You should refer to 2, showing a x-section with the appropriate dimensions defined, to make sure you understand the conventions that this program uses. You can set defaults for all of the values described below (except TER/DIV NO and station info) using the Change Default Data program (screen 12).

SCREEN 8

```
TERRACE/DIVERSION  X-SECTION  INFORMATION       SCREEN 8

    TER/DIV NO. 1

    REACH NO :    1    :    2    :    3    :    4    :    5    :

    FROM STA :  0+00
     TO  STA : 10+00
   FCS WIDTH :
   BOT WIDTH : 8
   FS  WIDTH : 15
   TOP WIDTH : 3
   BS  WIDTH :
   BCS WIDTH :
  BASE WIDTH :
   FCS RATIO : 5
   FS  RATIO :
   BS  RATIO : 5
  XSEC SHAPE : 1
                          X-SECTION SHAPE CODES
    1 - BROAD BASE      2 - STEEP BACK      3 - NARROW BASE     4 - DIVERSION

      Esc-MAIN MENU       Pg Dn-NEXT SCREEN        Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT TER/DIV     F8-PREV TER/DIV     F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screens 10 and 11.

TER/DIV NO. : This number indicates the current practice you are working on. Press *<F7>* to go to the next one

or <*F8*> to go to the previous one.

> ***NOTE!!*** You must use <*F7*> or <*F8*> to bring up all the practice lines used in order to fill the x-section information with default data.

FROM STA : You cannot change this value. For multiple reaches, this value will contain the TO STA from the previous reach.

TO STA : Enter the end station for the reach. If you desire only one x-section template for the practice, enter the last station of the practice for reach 1.

FCS WIDTH : Enter the desired front cut slope width in feet.

BOT WIDTH : Enter the channel bottom width in feet.

FS WIDTH : Enter the front slope width in feet.

TOP WIDTH : Enter the ridge/dike top width in feet.

BS WIDTH : Enter the back slope width in feet.

BCS WIDTH : Enter the back cut slope width in feet.

BASE WIDTH : Enter the ridge/dike base width in feet.

FCS RATIO : Enter the front cut slope ratio.

FS RATIO : Enter the front slope ratio.

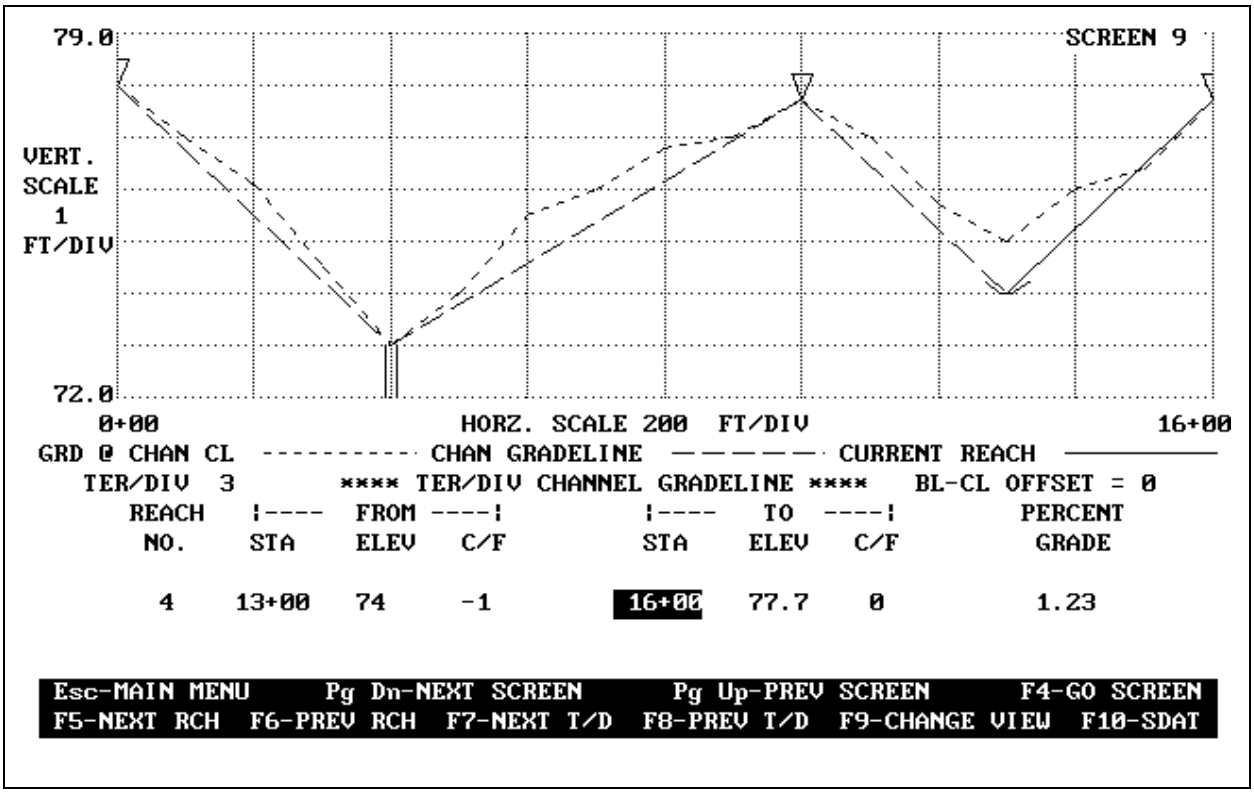
BS RATIO : Enter the back slope ratio.

XSEC SHAPE : Select the desired shape by entering the appropriate code. Available shapes are shown near the bottom of the screen. These shapes can be changed in the Change Default Data program (screen 4). The example above shows these to be 1 - Broad Base, 2 - Steep Back, 3 - Narrow Base, and 4 - Diversion. When a XSEC SHAPE code is entered, the slope ratios above are checked against the minimum values in the default file (screen 4). If the slope ratio is less than the minimum, the slope ratio is changed to the minimum.

SCREEN 9 - Channel Gradeline

Screen 9, shown below, is used to define the channel gradeline. This screen operates very similar to the outlet gradeline screen (screen 6). The top portion of the screen displays a profile view of the ground (short dashed line) and the channel gradeline (long dashed line) along the channel centerline. The location of any inlet and watershed break is also indicated in this view with graphical symbols. The lower part of the screen displays the beginning and ending station information for a particular reach. This information is described below. When entering this screen, the horizontal and vertical scales are automatically adjusted in order to fill the screen. See <*F9*> below to change the horizontal and vertical scales.

SCREEN 9



NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screens 10 and 11.

TER/DIV : This number indicates the current practice you are working on (3 in the example above). Press <*F7*> to go to the next one or <*F8*> to go to the previous one.

REACH NO. : This value indicates the current reach you are working on (4 in the example above). The current reach is also indicated in the view by a solid line. Press <*F5*> to move to next reach or <*F6*> to move to the previous one. The gradeline may be entered automatically from inlet to inlet by pressing <*F5*>. The maximum number of reaches is 12.

FROM STA : The beginning station of the current reach is shown here. It is either the beginning of the first reach or the end of the previous reach. You cannot edit this value.

FROM ELEV : You can enter the elevation of the channel gradeline at the start of the current reach. If a value is entered here, then the "FROM C/F" (see below) is calculated. If no value is entered, then "FROM C/F" or the "PERCENT GRADE" should be entered.

FROM C/F : You can enter the amount of cut (negative number) or fill (positive) for the gradeline at the beginning of this reach. If a cut/fill value is entered, the elevation is calculated.

TO STA : Enter the ending station of the current reach. If the value input here is less than the last station, a new reach will be added at the end with the "FROM STA" being the value entered here. You cannot enter a value greater than the last station.

TO ELEV : You can enter the elevation of the channel gradeline at the end of the current reach. If a value is entered here, then the "TO C/F" (see below) is calculated. If no value is entered, then "TO C/F" or the "PERCENT GRADE" should be entered.

TO C/F : You can enter the amount of cut (negative number) or fill (positive) for the gradeline at the end of this reach. If a cut/fill value is entered, the elevation is calculated.

PERCENT GRADE : You can enter a percent grade and let the program determine the elevation and cut/fill values for the end of the reach.

<F9> : Use to change the screen view of the gradeline. When you press *<F9>*, you are asked for the "FROM STA", the "TO STA", the "FROM ELEV", and the "TO ELEV". Entering these values will define the lower left and upper right corners of the section you wish to view. This section will then be redisplayed to fill the top portion of the screen. Pressing *<Enter>* without entering anything will leave the current value unchanged. If you wish to return to the original view, use either *<PgUp>* and then *<PgDn>* or *<F7>* and then *<F8>*.

SCREEN 10 - Channel Information

The type of lining in the channel and the erosion resistance of the channel are defined on the screen below. The example below shows an earth channel with average erosion resistance.

SCREEN 10

```
TERRACE/DIVERSION  CHANNEL  INFORMATION          SCREEN 10

    TER/DIV 2

  FROM     TO     DESIGN    LINING   EROSION   MAX ALLOW  STABILITY  CAPACITY
  STA      STA    Qp-CFS     TYPE     RESIST    VEL-FPS    VEL-FPS   DEPTH-FT

  0+00    6+00     5.1        1         2         2          1.5        .5
  6+00   10+00     4.5        1         2         2          1.6        .4
 10+00   13+00     2.8        1         2         2          1.5        .3
 13+00   15+00     2          1         2         2          1.4        .2









       LINING TYPE CODE  -  1 = EARTH          2 = GRASS
 EROSION RESISTANCE CODE  -  1 = RESISTANT     2 = AVERAGE  3 = EASILY ERODED

     Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT TER/DIV     F8-PREV TER/DIV     F10-STORE DATA
```

NOTE!! Changing or deleting any value on this screen (which is essentially changing the design) will clear any data from screen 11.

TER/DIV NO. : This number (2 in the example above) indicates the current practice you are working on. Press <*F7*> to go to the next one or <*F8*> to go to the previous one.

FROM STA : The beginning station of each reach is obtained from previous screens and cannot be changed here.

TO STA : The ending station of each reach is obtained from previous screens and cannot be changed here.

DESIGN Q_p-CFS : The peak flow at the end of each reach is calculated and displayed. It can not be edited.

LINING TYPE : Enter 1 for an earth (bare) channel or 2 for a grass channel.

EROSION RESIST : Enter the code corresponding to the type of resistance as follows: 1 for resistant, 2 for average, and 3 for easily eroded.

MAX ALLOW VEL-FPS : The maximum allowable velocity, in feet per second, for the channel is obtained from the default file based on lining type and erosion resistance. These values can be changed in the Change Default Data program (screen 9).

STABILITY VEL-FPS : The stability velocity, in feet per second, is computed using procedures in Appendix 0. The values used can be changed in the Change Default Data program (screen 9).

CAPACITY DEPTH-FT : The capacity depth, in feet, is computed using procedures in Appendix 0. The values used can be changed in the Change Default Data program (screen 9).

SCREEN 11 - Design Information

The Design Information screen, described in detail below, allows you to select the method to use to balance cut and fill volumes. The release time, release rate, pool depth, and pool volume apply only to UGO practices.

SCREEN 11

```
TERRACE/DIVERSION  DESIGN  INFORMATION          SCREEN 11

    TER/DIV 2

        C/F     REL.    REL.    POOL    POOL    CUT     FILL   BORROW   SPOIL
OUTLET  BAL.    TIME    RATE    DEPTH   VOL.    VOL.    VOL.    VOL.    VOL.
  ID   METHOD   HRS.    CFS.    FT.     ACF.    CYDS.   CYDS.   CYDS.   CYDS.

  A        1     10.8    .706     2.1     .383   55      1236    1182
  B        1    NA      NA       NA      NA      117     704     586









                   CUT/FILL BALANCE ADJUSTMENT METHOD CODES
 1-NONE    2-CHANNEL ELEV    3 - BCSW @ EACH X-SEC    4 - BCSW @ SELECT X-SEC

      Esc-MAIN MENU       Pg Dn-NEXT SCREEN       Pg Up-PREV SCREEN
  F4-GO SCREEN     F7-NEXT TER/DIV     F8-PREV TER/DIV     F10-STORE DATA
```

TER/DIV NO. : This number indicates the current practice you are working on. Press <*F7*> to go to the next one or <*F8*> to go to the previous one.

OUTLET ID : This indicates which outlet you are designing. You cannot edit this value, since it is retrieved from screen 3.

C/F BAL. METHOD : This is the only input column on this screen. You should enter the number corresponding to the cut/fill balance method you wish to use. The codes, listed near the bottom of the screen, are as follows: 1-None (do not balance); 2-Channel Elev; 3-BCSW @ Each X-Sec; 4-BCSW @ Select X-Sec. For more explanation of these methods, see the procedures section in Appendix 0, page 96. After selecting the desired method, calculations will begin. This might take some time, since several trials may be required. This number must be entered for each outlet on each practice.

REL. TIME, HRS. and
REL. RATE, CFS. : The release time (hours) and the release rate (cubic feet per second) are calculated and displayed.

POOL DEPTH, FT. and
POOL VOL., ACF. : The depth (feet) and volume (acre feet) of any pool is also calculated and displayed. The pool depth is measured from the inlet elevation to the design pool elevation.

CUT VOL., CYDS. ,
FILL VOL., CYDS. ,
BORROW VOL., CYDS. and
SPOIL VOL., CYDS. : The cut, fill, borrow, and spoil volumes are calculated and displayed in cubic yards.

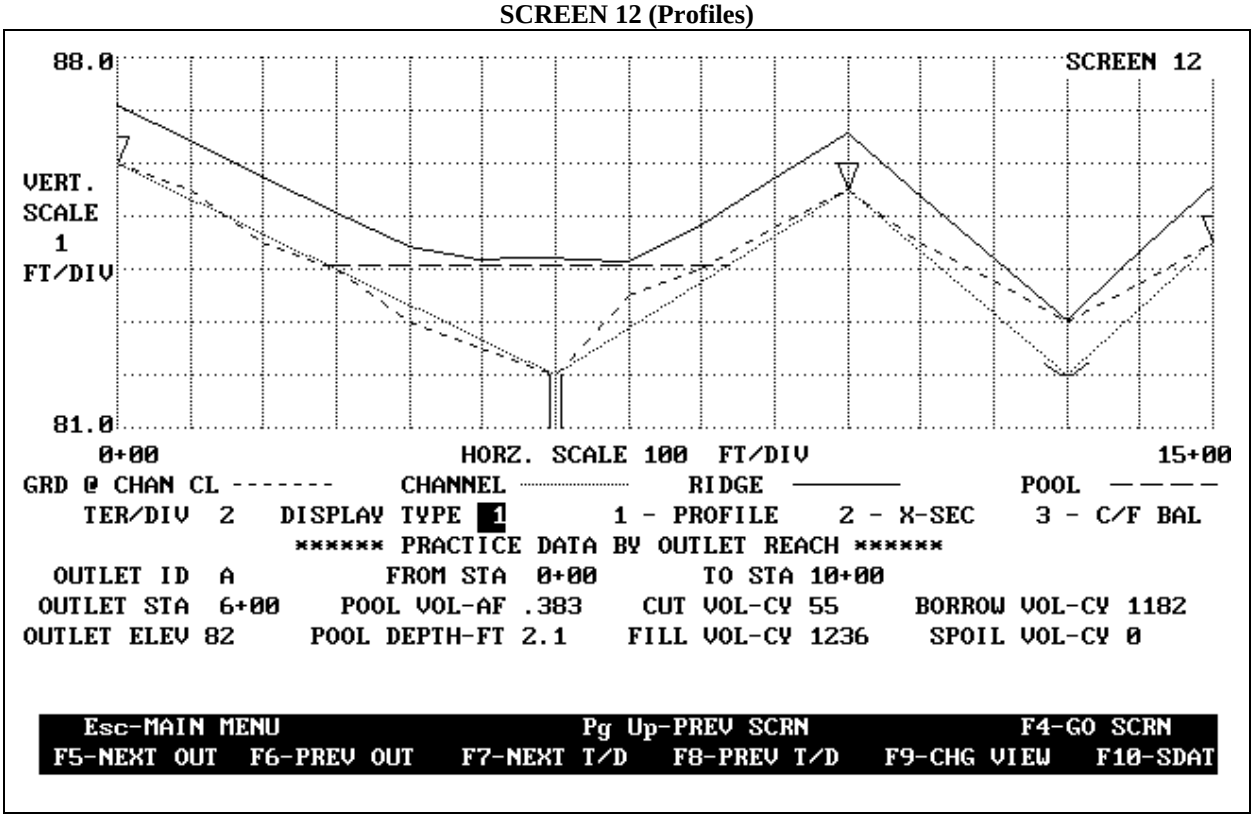
SCREEN 12 - Views of Profile, Cross-Section, and Cut/Fill Balance Profile

Screen 12 gives you "three screens for the price of one". The three types of displays are shown and described below. This screen is similar in layout to screens 6 and 9. The top portion of the screen displays the graphical view while the lower portion displays numerical values related to the view. When entering this screen, the horizontal and vertical scales are automatically adjusted in order to fill the screen. See <*F9*> below to change the horizontal and vertical scales.

DISPLAY TYPE : This is the only input field on this screen. It allows you to choose the type of display you wish to view. The display types are 1 - a profile of the practice, 2 - cross sections along the practice, and 3 - a cut/fill balance profile for the practice. These are discussed in more detail below.

TER/DIV : This number indicates the practice you are viewing. Use <*F7*> to move to the next practice or <*F8*> to the previous one. If you are on a screen other than the profile and you press <*F7*> or <*F8*>, you will move to next/previous practice and be placed on the profile screen.

SCREEN 12 (Profiles)



The upper portion of the PROFILE display, shown above, allows you to view the elevations of the ground along the channel centerline (short dashed line), the channel (dotted line), the ridge (solid line), and any pool (long dashed line) that may exist for a particular practice The lower portion informs you of values related to a specific outlet reach. The values displayed are described below.

OUTLET ID : This indicates the outlet reach that relates to the data in the lower part of the screen. Use <*F5*> to move to next outlet or <*F6*> to previous one.

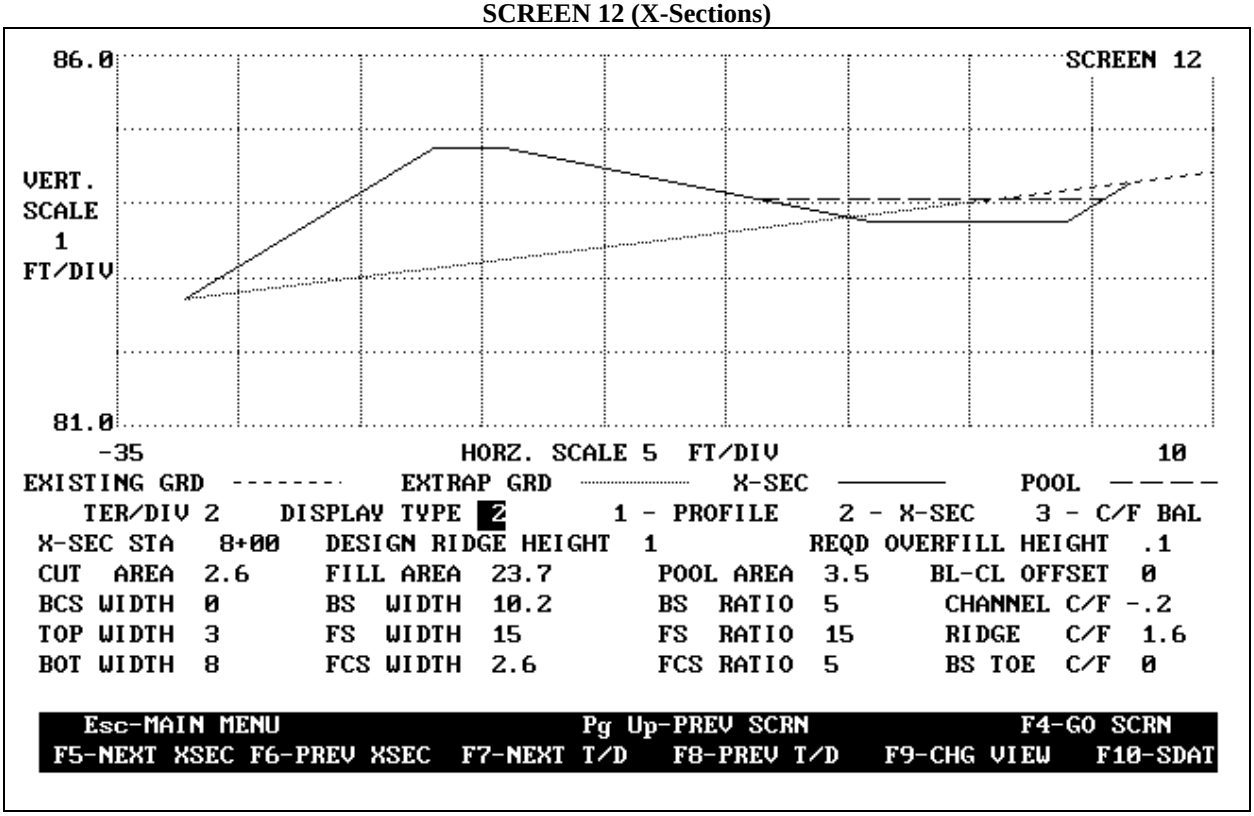
FROM STA, and
TO STA : These values describe the start and end of the outlet reach.

OUTLET STA, and
OUTLET ELEV : These values are the location, along the practice, and the elevation of the outlet.

POOL VOL-AF, and
POOL DEPTH-FT : The volume, in acre-feet, and the depth, in feet, of the pool are displayed here.

CUT VOL-CY ,
FILL VOL-CY ,
BORROW VOL-CY and
SPOIL VOL-CY : The cut, fill, borrow, and spoil volumes are displayed in cubic yards.

SCREEN 12 (X-Sections)



The upper portion of the X-SEC display, shown above, allows you to view the cross-sections along the practice at each station. Shown in the view are the existing groundline (short dashed line); the groundline extrapolated from the ground data (dotted line); the cross-sectional shape template (solid line), which was entered on screen 8; and the pool (long dashed line). The lower portion informs you of values related to a specific cross-section. The values displayed are described below.

X-SEC STA : This indicates the station along the practice of this specific cross-section. Use *<F5>* to move to the next cross-section or *<F6>* to the previous one.

CUT AREA,
FILL AREA, and
POOL AREA : These area values are displayed in square feet.

Most of the following values are defined graphically in 2.

DESIGN RIDGE HEIGHT : The design ridge height in feet.

REQD OVERFILL HEIGHT : The required overfill height in feet.

BCS WIDTH : The back cut slope width in feet.

BS WIDTH : The back slope width in feet.

BS RATIO : The back slope ratio (horizontal distance over vertical distance). This is dimensionless.

TOP WIDTH : The top width of the ridge in feet.

BOT WIDTH : The bottom width of the channel in feet.

FS WIDTH : The front slope width in feet.

FS RATIO : The front slope ratio (horizontal distance over vertical distance). This is dimensionless.

FCS WIDTH : The front cut slope width in feet.

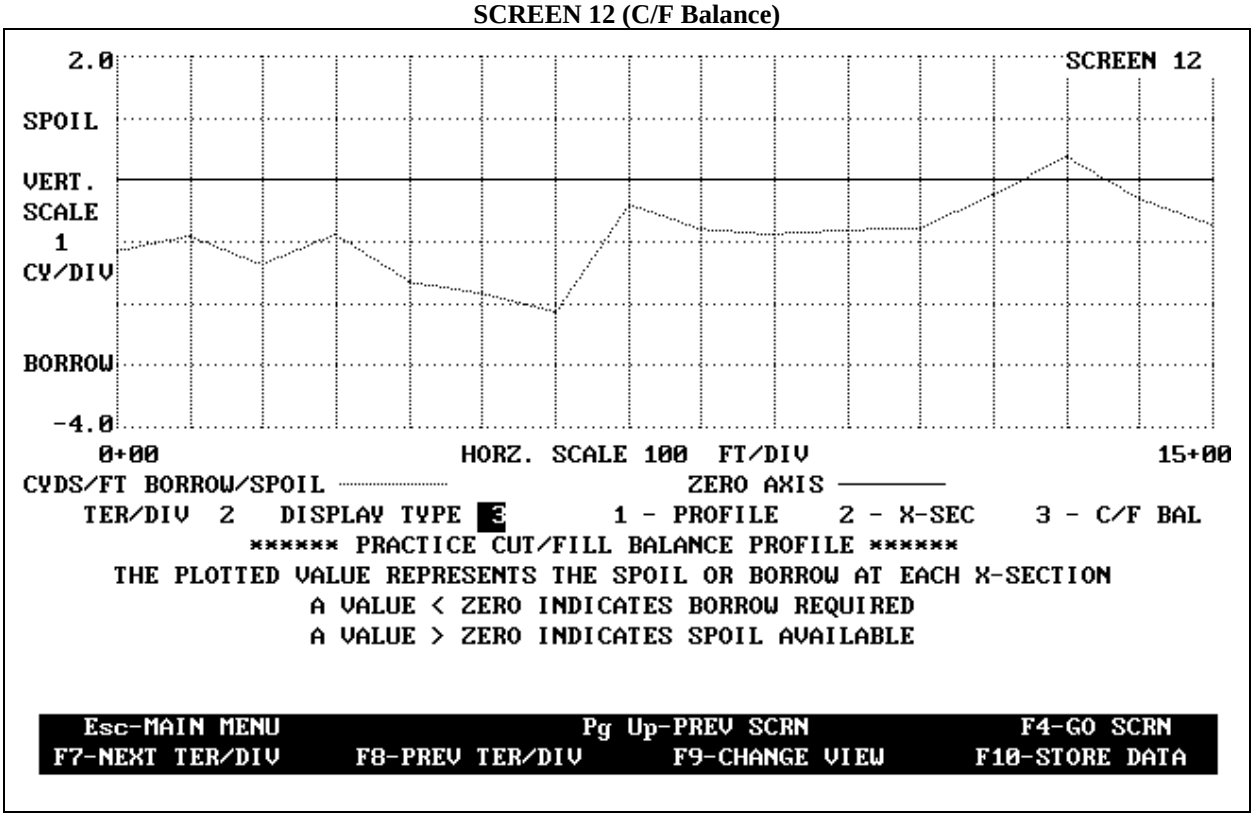
FCS RATIO : The front cut slope ratio (horizontal distance over vertical distance). This is dimensionless.

CHANNEL C/F : The amount of cut or fill in feet at the centerline of the channel. A negative number indicates a cut; whereas a positive number indicates fill.

RIDGE C/F : The amount of cut or fill in feet at the centerline of the ridge. A negative number indicates a cut; whereas a positive number indicates fill.

BS TOE C/F : The amount of cut or fill in feet at the toe of the back slope. A negative number indicates a cut; whereas a positive number indicates fill.

SCREEN 12 (C/F Balance)



The upper portion of the C/F BAL display, shown above, allows you to view the cut/fill balance profile for a single practice. The view consists of a borrow/spoil line (dotted line), which indicates cubic yards per foot, and a zero axis (solid line). When the borrow/spoil line falls above the zero axis, it indicates spoil available. When it falls below, it indicates borrow required. The lower portion on this screen only provides help concerning the view.

<F9> : Use to change the screen view. When you press *<F9>*, you are asked for the "FROM STA" ("FROM DIST" for display 2), the "TO STA" ("TO DIST" for display 2), the "FROM ELEV", and the "TO ELEV" (for display 3, the ELEV values refer to the spoil/borrow volumes). Entering these values will define the lower left and upper right corners of the section you wish to view. This section will then be redisplayed to fill the top portion of the screen. Pressing *<Enter>* without entering anything will leave the current value unchanged. If you wish to return to the original view, use either *<PgUp>* and then *<PgDn>* or *<F7>* and then *<F8>*.

PRINT/PLOT DATA MODULE

This program allows the user to print out any combination of the following items: a cover page, ground data, design data, layout data, quantity data and vertical control data. You can also plot any combination of profiles and cross-sections. If you want to print or plot ground data or vertical control data, you should have previously entered some data using the Input Ground Data program. If you want to print or plot any of the other data, it is assumed you have previously designed a system using the Design program.

SCREEN 1 - File Information

The screen below is the first screen of the print/plot data module. It is where the filename information is entered.

SCREEN 1

```
PRINT / PLOT DATA                    SCREEN #1



    DRIVE:\PATH\ WHERE DATA IS LOCATED ---->  A:\
          TER/DIV DESIGN DATA FILENAME ---->  SAMPLE
        PRACTICE GROUND DATA FILENAME ---->  SAMPLE
          OUTLET GROUND DATA FILENAME ---->  SAMPLE
       VERTICAL CONTROL DATA FILENAME ---->  SAMPLE
A:\
SAMPLE  .DES
 218112 Bytes free



              Esc - MAIN MENU                 Pg Dn - NEXT SCREEN
  F2-LIST FILES     F3-REPEAT ENTRY     F4-GO SCREEN     F5-PRINT/PLOT DATA
```

DRIVE:\PATH\ WHERE DATA IS LOCATED : This value indicates where your data is stored (e.g., A:\ or C:\TERDATA\ ). It is retrieved from the default file, but can be changed at this time. If it is left blank, the current drive and directory will be used (normally, the same place the program is stored).

NOTE!! If you press <*Delete*> on any of the filename fields (except VERTICAL CONTROL DATA FILENAME), the other filenames are removed. If you change the name of either ground data file, the design data filename is removed.

TER/DIV DESIGN DATA FILENAME : The name of a file that contains data from a previously created practice design (one that has been previously stored using the Design program). The filename should be limited to 8 characters. The extension of ".DES" is automatically added to the name. Pressing <*F2*> while on this field (or any filename field below) will list all of the appropriate data files in the middle section of the

screen (e.g., SAMPLE.DES in the screen shown above) and the amount of storage space left on the disk (e.g., 218112 bytes free). The filenames below will be retrieved also. If you are not printing or plotting design data, skip this field.

PRACTICE GROUND DATA FILENAME : The name of a file that contains previously stored ridge and channel ground data from the Input Ground Data program. The extension of ".GRD" is automatically added to the name. If you do not want to print the ground data, leave this blank.

OUTLET GROUND DATA FILENAME : The name of a file that contains previously stored outlet ground data from the Input Ground Data program. The extension of ".OGD" is automatically added to the name. If you do not want to print the outlet ground data, leave this blank.

VERTICAL CONTROL DATA FILENAME : The name of a file that contains previously stored control data from the Input Ground Data program. The extension of ".VCD" is automatically added to the name. If you do not want to print this data, leave this blank.

SCREEN 2 - Cover Page / Page Heading Data

Screen 2, shown below, deals with the cover page and the page heading of the printed output. All of the data below is printed on the cover page and most of it is printed at the top of every other page. The agency/company ID and address is read from the default file (screen 1 in the Change Default Data program) and can be changed here. The landowner name, location, and designer are retrieved from the vertical control data file (screen 1 of the Input Ground Data program), but also can be entered here.

SCREEN 2

```
COVER PAGE / PAGE HEADING DATA              SCREEN #2


     AGENCY/COMPANY ID ----> BOONE COUNTY
                STREET ----> 555 VANDIVER
                  CITY ----> COLUMBIA
                 STATE ----> MO
                  ZIP  ----> 65202

        LANDOWNER NAME ----> JOHN SMITH
              TOWNSHIP ----> 26N
                 RANGE ----> 31W
               SECTION ----> 12
             FIELD NO. ----> 10
             DESIGNER  ----> TOM KEEP




   Esc - MAIN MENU       Pg Dn - NEXT SCREEN       Pg Up - PREVIOUS SCREEN
   F3 - REPEAT ENTRY          F4 - GO SCREEN          F5 - PRINT/PLOT DATA
```

SCREEN 3 - Printed Data Selection

Screen 3, shown below, is divided into two sections. The first section is Data Selection, where you can specify which practices and outlets to print. The Printout Type Selection section determines what reports are printed for the selected practices and outlets. Simply enter an X in the appropriate fields or a value as noted below. Press *<Delete>* to remove an X or a value. The defaults for this screen can be set in the Change Default Data program (screen 14). A new page is started for each report option listed below. Samples of the output can be seen in Appendix 0.

SCREEN 3

```
PRINTED DATA SELECTION                  SCREEN #3

     DATA SELECTION
                      ALL PRACTICES ---->
                      ALL   OUTLETS ---->
                  SELECTED PRACTICE ----> 2
                   SELECTED  OUTLET ----> A
     PRINTOUT TYPE SELECTION
                          COVER PAGE ----> X
                     PRACTICE GROUND ----> X
                       OUTLET GROUND ----> X
                     COMPLETE DESIGN ---->
                  ABBREVIATED DESIGN ----> X
              CHANNEL & RIDGE LAYOUT ---->
                    X-SECTION LAYOUT ---->
              CONDUIT & INLET LAYOUT ---->
                 DETAILED QUANTITIES ----> X
                    TOTAL QUANTITIES ----> X
               VERTICAL CONTROL DATA ----> X
            ENTER X OR THE REQUESTED VALUE NEXT TO DESIRED OUTPUTS


   Esc - MAIN MENU       Pg Dn - NEXT SCREEN       Pg Up - PREVIOUS SCREEN
   F3 - REPEAT ENTRY          F4 - GO SCREEN          F5 - PRINT/PLOT DATA
```

ALL PRACTICES, and
ALL OUTLETS : Putting an X next to either of these will print all of the practices and/or all of the outlets in the system.

SELECTED PRACTICE : If you want data for just one practice printed, enter the number of the desired practice here. If a value is entered here, an X in "ALL PRACTICES" is ignored.

SELECTED OUTLET : If you want data for just one outlet printed, enter the letter of the desired outlet here. If a value is entered here, an X in "ALL OUTLETS" is ignored.

COVER PAGE : An X here will print the cover page which contains all of the information on screen 2 of this program as well as the filename information from screen 1.

PRACTICE GROUND, and
OUTLET GROUND : Placing an X on either of these will print the appropriate ground data entered on screen 3 of the Input Ground Data program. The height of instrument (HI) and either foresights (FS) or elevations (ELEV) and distances (DIST), will be printed for each station.

COMPLETE DESIGN : This option will print all of the information from screens 2 through 11 in the Design Program. In addition, flood volumes and sedimentation volumes are printed.

ABBREVIATED DESIGN : A condensed report of practice, outlet, and inlet information is printed.

CHANNEL & RIDGE LAYOUT : A worksheet is printed to be used in the layout of the channel and ridge. Blanks are given for H.I. and planned grade rod, actual grade rod, and the difference between the two for the channel and the ridge. A new page is started for each practice line.

X-SECTION LAYOUT : A sheet is printed detailing various dimensions of each x-section. Refer to 2 and 3 for a definition of the dimensions. Blanks are provided to checkout a x-section at a particular station. A new page is started for each practice line.

CONDUIT & INLET LAYOUT : This worksheet for conduits and inlets is very similar to the one for channels and ridges above. A new page is started for each outlet.

DETAILED QUANTITIES : A detailed report of earthwork quantities and seeding area by practice and conduit and inlet quantities by outlet is printed.

TOTAL QUANTITIES : This will print a summary of the detailed quantities above.

VERTICAL CONTROL DATA : Selecting this will print the data entered on screen 2 of the Input Ground Data program. It will print just as it appeared on the screen with the exception that more than one screen is printed on a page.

SCREEN 4 - Plotted Data Selection

Screen 4, shown below, is also divided into two sections. The first section is Data Selection, where you can specify which practices and outlets to plot. The Plot Type Selection section determines what views are plotted (displayed) for the selected practices and outlets. Simply enter an X in the appropriate fields or a value as noted below. Press <*Delete*> to remove an X or a value. Samples of the output can be seen in Appendix 0. The defaults for this screen can be set in the Change Default Data program (screen 15).

SCREEN 4

```
PLOTTED DATA SELECTION                  SCREEN #4

     DATA SELECTION
                        ALL PRACTICES ----> _
                        ALL   OUTLETS ---->
                    SELECTED PRACTICE ----> 2
                     SELECTED  OUTLET ----> A
     PLOT TYPE SELECTION
                      PRACTICE PROFILE ----> X
                        OUTLET PROFILE ----> X
                  SPOIL/BORROW PROFILE ----> X
          PROFILE HORIZ SCALE (FT/IN) ----> 200
           STANDARD TYPICAL X-SECTION ---->
              ALL PRACTICE X-SECTIONS ---->
         SELECTED X-SECTIONS FROM STA ---->   8+00
                               TO STA ---->   8+00
                    ALLOW NOTE ENTRY ----> X
                  VIEW WITHOUT PRINTING ----> X

            ENTER X OR THE REQUESTED VALUE NEXT TO DESIRED OUTPUTS


   Esc - MAIN MENU       Pg Dn - NEXT SCREEN       Pg Up - PREVIOUS SCREEN
   F3 - REPEAT ENTRY          F4 - GO SCREEN          F5 - PRINT/PLOT DATA
```

> ***NOTE!!*** In order to print the plots, the program GRAPHICS.COM is required. The GRAPHICS.COM program is not supplied with the Terrace/Diversion Design Program. The GRAPHICS.COM program should be available as a DOS program. The user's system should have a PATH to the DOS programs or the GRAPHICS.COM file should be placed in the program directory of the Terrace/Diversion Design Program.
>
> If "View Without Printing" is NOT selected, the plots will print automatically. If you have very many, this will take some time; so, plan accordingly.

ALL PRACTICES, and
ALL OUTLETS : Putting an X next to either of these will print all of the practices and/or all of the outlets in the system.

SELECTED PRACTICE : If you want data for just one practice plotted, enter the number of the desired practice here. If a value is entered here, an X in "ALL PRACTICES" is ignored.

SELECTED OUTLET : If you want data for just one outlet plotted, enter the letter of the desired outlet here. If a value is entered here, an X in "ALL OUTLETS" is ignored.

PRACTICE PROFILE : A profile showing elevations of the channel centerline, the ground at the channel centerline, the maximum pool, and the constructed ridge is displayed for the selected practice(s).

OUTLET PROFILE : A profile of outlet and ground elevations along the centerline of the outlet is displayed for the selected practice(s).

SPOIL/BORROW PROFILE : Choosing this will display a line indicating the cubic yards per foot of either spoil available or borrow required for the selected practice(s).

PROFILE HORIZ SCALE (FT/IN) : Entering a scale in feet per inch will adjust the horizontal axis of the three profiles above. If no value is entered here, the profiles are automatically scaled to fill the page. If the scale entered causes the plot to extend beyond the page limits, multiple pages will be plotted.

STANDARD TYPICAL X-SECTION : This is a plot of a typical cross section for the type selected. It basically defines the dimensions and slope ratios.

ALL PRACTICE X-SECTIONS : This option will plot all of the cross-sections for the selected practice(s). The pool, cut, and fill areas are displayed with each x-section.

> ***NOTE!!*** If the ALL option is selected and the practice contains many x-sections, a large amount time will be required to print them (approximately 2 minutes per x-section).

SELECTED X-SECTIONS FROM STA, **TO STA** : If you wish to plot a select few of the cross-sections, enter the beginning and ending stations (don't enter "+", it is added automatically) of the x-sections you want to plot. Entering a "FROM STA" and not a "TO STA" will plot from the "FROM STA" to the end of the practice. Entering a "TO STA" without a "FROM STA" will plot from the beginning of the practice to the "TO STA". If either of these is entered, an X in "All Practice X-Sections" is ignored.

ALLOW NOTE ENTRY : Selecting this option will allow you to enter your own notes on each plot. When the plot is displayed, a window will appear asking you to enter your note. You can then take the following steps.

1. Type any text you wish to add and press <*ENTER*>.

2. You can then position the note by using the arrow keys. To move in smaller increments, press <-> (the minus key) a few times. To move in larger increments, press <+> (the plus key) a few times.

3. After positioning, press <*ENTER*> to secure the note.

4. You can now either press <*Insert*> to enter another note, <*Delete*> to delete the last note, or <*PgDn*> to continue.

VIEW WITHOUT PRINTING : If you just want to view the plots without printing them, select this option. If you decide that you would like to print a plot that you are viewing, you have that option also. Press <*Delete*> to remove message from the screen and then <*PrintScreen*> to print the plot. After it is printed, press any key to continue.

CHANGE DEFAULT DATA MODULE

This program is used with all of the different modules in Terrace/Diversion Design to edit and store data that is frequently entered, data that represents program restraints such as maximums and minimums, and input data that may change from area to area such as rainfall data and user identification. Each screen and its contents are discussed below.

DATA CAN BE STORED AT ANYTIME BY PRESSING <*F10*> !

Storing your data intermittently would be advised to avoid data loss due to power interruptions or if you wish to quit and return to this later. For more information on <*F10*>, see the section on key conventions (page 3).

SCREEN 1 - User Identification

Screen 1, shown below, contains data having to do with heading information and printouts. The data from this screen is used in the print program as header data on the cover page. The input fields should be self-explanatory.

SCREEN 1

```
SCREEN #1
                        USER IDENTIFICATION

USER ID --------------------------->   BOONE COUNTY
STREET ---------------------------->   555 VANDIVER
  CITY ---------------------------->   COLUMBIA
 STATE ---------------------------->   MO.
   ZIP ---------------------------->   65202




          Esc-MAIN MENU                      Pg Dn-NEXT SCREEN
    F3-REPEAT ENTRY           F4-GO SCREEN              F10-SAVE DATA
```

SCREEN 2 - Conduit Type and Maximum Velocity

Screen 2, shown below, lists up to 6 conduit types and the maximum velocity related to each. You can modify these to meet your needs. You should be aware when entering the description that the first six characters are displayed on screen 7 of the Design program and used in printouts in the Print/Plot program. For example, in the screen below, abbreviations are used to start the descriptions.

SCREEN 2

```
CONDUIT TYPE AND MAXIMUM VELOCITY           SCREEN #2

   TYPE      MAX VEL   DESCRIPTION

     1         5         PCPT  - PERFORATED CORRUGATED POLYETYLENE TUBING

     2         10        CPT   - CORRUGATED POLYETYLENE TUBING

     3         5         TILE  - CLAY OR CONCRETE TILE

     4         20        PVC   - POLYVINYL CHLORIDE PIPE

     5         20        CMP   - CORRUGATED METAL PIPE

     6


         Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
       F3-REPEAT ENTRY           F4-GO SCREEN          F10-STORE DATA
```

SCREEN 3 - Conduit N-Value

On the conduit N-value screen (screen 3), shown below, you can change the N-values for conduits ranging in size from 3 to 24 inches. This is done for the conduit types defined on screen 2 above. These values are used in the Design program.

SCREEN 3

CONDUIT N-VALUE SCREEN #3

	SIZE (INCHES)										
TYPE	3	4	5	6	8	10	12	15	18	21	24
1	.015	.015	.015	.015	.015	.017	.017	.017	.017	.02	.02
2	.015	.015	.015	.015	.015	.017	.017	.017	.017	.02	.02
3	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013	.013
4	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011	.011
5	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025	.025
6											

Esc-MAIN MENU Pg Dn-NEXT SCREEN Pg Up-PREV SCREEN
F3-REPEAT ENTRY F4-GO SCREEN F10-STORE DATA

SCREEN 4 - Design Section (Minimum Slope Ratio)

Screen 4, which is shown below, is used to specify up to 4 different cross-section shapes (screen 8 of the Design program) and the minimum slope ratios associated with each. These ratios are shown graphically in 2.

SCREEN 4

DESIGN SECTION SCREEN #4

MINIMUM SLOPE RATIO

TYPE	CUT SLOPE	FRONT SLOPE	BACK SLOPE
1 - BROAD BASE	5	5	5
2 - STEEP BACK	5	5	2
3 - NARROW BASE	5	2	2
4 - DIVERSION	4	4	4

Esc-MAIN MENU Pg Dn-NEXT SCREEN Pg Up-PREV SCREEN
F3-REPEAT ENTRY F4-GO SCREEN F10-STORE DATA

SCREEN 5 - % Settlement By Section Type

You can set the percent of settlement for each cross-section type, defined in screen 4 above, by using screen 5, shown below. These values are used by the Design program.

SCREEN 5

```
SCREEN #5

                        % SETTLEMENT BY SECTION TYPE

                  TYPE                      % SETTLEMENT

                    1 -                       10

                    2 -                       10

                    3 -                       20

                    4 -                       10



         Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
        F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

SCREEN 6 - Rainfall, Terrace Spacing, Design Section

Screen 6 contains three sections (rainfall, terrace spacing, and design) as shown in the example below. The values on this screen are used in the Design program.

SCREEN 6

```
SCREEN #6

  RAINFALL

                    Design Storm Frequency ------>  10    yr
               Design Storm Rainfall Depth ------>  5     in

  TERRACE SPACING

                Minimum Required Spacing ------>  90   ft
                   Maximum Terrace Length ----->  3500 ft

  DESIGN SECTION

           Downslope Borrow Finished Grade ----->  1     %
          Minimum Topwidth @ Design Height ----->  3     ft
     Minimum Bottom width @ Design Channel ----->  3     ft
                     Minimum Design Height ----->  1     ft
    Pressure Flow Calc. Assumed Pool Depth ----->  2     ft



         Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
        F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

Design Storm Frequency : Specify the storm frequency you wish to use in years.

Design Storm Rainfall Depth : Enter the desired design depth in inches.

Minimum Required Spacing : This value is for information only and is currently not checked by the program.

Maximum Terrace Length : This value is for information only and is currently not checked by the program.

Downslope Borrow Finished Grade : This equals 100 divided by the back cut slope width ratio shown in 2.

Minimum Topwidth @ Design Height : Enter the minimum topwidth (feet) allowed at the design ridge height. This is illustrated in 3.

Minimum Bottom width @ Design Channel : Enter the minimum channel bottom width (feet) allowable. Bottom width is illustrated in 2.

Minimum Design Height : Enter the minimum design ridge height (feet) allowable. Ridge height is illustrated in 2.

Pressure Flow Calc. Assumed Pool Depth : This is the depth which the design program will use to start calculation trials and in figuring head between pools or between the last pool and the end of the outlet.

SCREEN 7 - Inlet Characteristics, Release Rates, Sediment Storage

Screen 7 also contains three sections (inlet characteristics, minimum and maximum release rates, and sediment storage) as shown in the screen below. The values on this screen are used by the Design program.

SCREEN 7

```
INLET CHARACTERISTICS                                          SCREEN #7

                      Minimum inlet depth ----->  3    ft
        % of inlet opening assumed plugged ----->  50   %
          % of Top opening assumed plugged ----->       %
      Hydraulic head - % of Terrace Height ----->  70   %
                          Orifice C value ----->  .6
            Ke (Entrance loss coeffecient) ----->  3

  MIN. & MAX. RELEASE RATES

                         Minimum Discharge ----->  .05 cfs/acre
                         Maximum Discharge ----->  .5  cfs/acre

  SEDIMENT STORAGE

                            Delivery Ratio ----->  90  %
                           Trap Effeciency ----->  90  %
                               Design Life ----->  10  years
                     Sediment Dry Density ----->  90  lbs/ft^3


         Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
        F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

Minimum inlet depth : Specify the smallest inlet depth (feet) allowable. This depth is described in 4 on page 8.

% of inlet opening assumed plugged : Specify the percentage of the inlet opening area that is assumed to be plugged.

% of Top opening assumed plugged : Specify the percentage of the top opening area that is assumed to be plugged.

Hydraulic head - % of Terrace Height : Enter the percent of the pool depth to be used for inlet hydraulic calculations.

Orifice C value : Enter the C value (discharge coefficient) you wish to use for orifice flow calculations.

K_e (Entrance loss coefficient) : Enter the coefficient to be used for calculating inlet entrance losses.

Minimum Discharge : The smallest rate of discharge that you want to occur should be entered here in cubic feet per second per acre (cfs/acre).

Maximum Discharge : The largest rate of discharge that you want to occur should be entered here in cubic feet per second per acre (cfs/acre).

Delivery Ratio : Enter the percentage of the soil loss that reaches the pool.

Trap Efficiency : Enter the percentage of the soil loss that reaches the pool and remains in the pool.

Design Life : Enter the number of years worth of sediment to be stored in the pool.

Sediment Dry Density : The dry density (in pounds per cubic foot) of the sediment used in calculating sediment storage.

SCREEN 8 - Inlet Characteristics

Inlet characteristics are defined on screen 8. An example is shown below. You can enter information for up to 15 inlets. This can be any combination of 1 to 4 different inlet types. This information is used by the Design program. Refer to 4 on page 8 for a picture of the dimensions listed here.

SCREEN 8

INLET CHARACTERISTICS SCREEN #8

TYPE	SIZE	FLOW AREA (FT^2)	HEIGHT (FT)	INLET OPEN AREA (FT^2/FT)	TOP OPEN AREA (FT^2)
MO-I	5	.136	4	.136	
MO-I	6	.196	4	.163	
MO-I	8	.349	4	.218	
MO-I	10	.545	4	.273	
MO-I	12	.785	4	.327	
MO-II	5	.136	1	.136	.136
MO-II	6	.196	1	.163	.196
MO-II	8	.349	1	.218	.349
MO-II	10	.545	1	.273	.545
MO-II	12	.785	1	.327	.785
NEBR	5	.136	4	.163	
NEBR	6	.196	4	.196	
NEBR	8	.349	4	.262	
NEBR	10	.545	4	.327	
NEBR	12	.785	4	.392	

Esc-MAIN MENU Pg Dn-NEXT SCREEN Pg Up-PREV SCREEN
F3-REPEAT ENTRY F4-GO SCREEN F10-STORE DATA

TYPE : Enter a short description (or abbreviation) of the type of inlet. This type is repeated for each different size, as shown above. You can enter from 1 to 4 different types. These types will be displayed on screen 5 in the Design program.

SIZE : Enter the inlet size (nominal diameter) in inches.

FLOW AREA (FT^2) : This column is the flow area of the inlet given in square feet.

HEIGHT (FT) : Enter the distance the inlet extends above ground in feet.

INLET OPEN AREA (FT^2/FT) : The inlet opening area refers to the area of the holes in the side of the inlet. It is determined by taking the total hole area and dividing by the inlet height to get a value in square feet per foot.

TOP OPEN AREA (FT^2) : This is the area at the top of the inlet. If the top of the inlet is closed, leave this blank or enter 0. Enter this value in square feet.

SCREEN 9 - Channel Flow Factors

The channel flow factors for bare and grassed channels are entered on screen 9. The factors are described below.

SCREEN 9

```
BARE CHANNEL FLOW FACTORS                    SCREEN #9

                     ALLOWABLE VELOCITY (FPS)
                EROSION RESISTANT -------->   2.5
                AVERAGE RESISTANCE ------->   2
                EASILY ERODED ------------>   1.5
                           MANNING'S N VALUE
                CAPACITY N VALUE --------->   .06
                STABILITY N VALUE -------->   .035

                GRASSED CHANNEL FLOW FACTORS

                     ALLOWABLE VELOCITY (FPS)
                EROSION RESISTANT -------->   5
                AVERAGE RESISTANCE ------->   4
                EASILY ERODED ------------>   3
                           COVER INDEX VALUE
                CAPACITY CI VALUE -------->   5.6
                STABILITY CI VALUE ------->   4.44



      Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
     F3-REPEAT ENTRY          F4-GO SCREEN         F10-STORE DATA
```

ALLOWABLE VELOCITY (FPS) : Enter the velocity values in feet per second for EROSION RESISTANT, AVERAGE RESISTANCE, and EASILY ERODED channels. These must be entered for both bare and grassed channels.

MANNING'S N-VALUE : Enter the CAPACITY and STABILITY N values that pertain to bare channels.

COVER INDEX VALUE : Enter the CAPACITY and STABILITY cover index values that pertain to grassed channels. These are retardance factors for grass (see equation 16 in Appendix 0 and the table associated with that equation).

SCREEN 10 - Required Runoff Storage Volume

Screen 10 is used to select the method for calculating the required runoff storage volume. The choices are as follows: 1 - floodrouting with the formula shown on the screen below; 2 - use the total volume of runoff from design storm; or 3 - use a user defined fixed volume of storage (acre-inches/acre). Simply enter the number corresponding to the method desired, the coefficient (A) and the exponents (B and C) for the formula, and a fixed volume.

SCREEN 10

```
REQUIRED RUNOFF STORAGE VOLUME            SCREEN #10

VOLUME CALCULATED BY NUMBER (1,2 OR 3) ---->  1

1- FLOODROUTING WITH FORMULA GIVEN BELOW

    VS = A * (VR)^B / (Q)^C

    Q - DISCHARGE RATE (CFS)        A ---->   .0223

    VS - VOL STORAGE (AC-FT)        B ---->   1.27

    VR - VOL RUNOFF  (AC-IN)        C ---->   .27

2- TOTAL VOLUME OF RUNOFF FROM DESIGN STORM

3- FIXED VOLUME OF STORAGE (AC-IN/AC) ---->   2




         Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
        F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

SCREEN 11 - Miscellaneous

The miscellaneous screen, shown below, defines a variety of variables as discussed in detail below.

SCREEN 11

```
MISCELLANEOUS                                                SCREEN #11

          Practice  Baseline to Centerline Offset ----->       ft

            Outlet  Baseline to Centerline Offset ----->       ft

          Overland (Sheet Flow) Manning's n value ----->  .06

                              Maximum Release Time ----->  30   hours

                                 C/F Density Ratio ----->  1

               Drive:\Path\ where Data is located -----> A:

                 Maximum Number of Practice Lines ----->  8

                   Maximum Number of Outlet Lines ----->  5

             Maximum Number of X-sections per Line ----->  30

    Maximum Number of Ground Points per X-section ----->  7

          Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
         F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

Practice Baseline to Centerline Offset : This is the distance (in feet) from the baseline (flagline) to the channel centerline of the practice. While looking in the direction of increasing station, a channel centerline to the right of the baseline results in a positive offset, while one to the left results in a negative offset (see 1 in the Stationing Convention section).

Outlet Baseline to Centerline Offset : This is the distance (in feet) from the baseline (flagline) to the centerline of the outlet. While looking in the direction of increasing station, a centerline to the right of the baseline results in a positive offset, while one to the left results in a negative offset (see 1 in the Stationing Convention section).

Overland (Sheet Flow) Manning's n value : Enter the roughness coefficient you want used in the time of concentration calculations.

Maximum Release Time : This is the maximum amount of time (in hours) you want to allow for runoff to be released.

C/F Density Ratio : This is the cut soil dry density divided by the fill dry density or the cubic yards of fill resulting from ONE cubic yard of cut.

Drive:\Path\ where Data is located : You should indicate here the drive and path of where you intend to store your data. This should conform to DOS conventions. A couple of examples are A:\ (the root directory of drive A) or C:\TERDATA\ (the directory TERDATA on drive C).

> ***NOTE!!*** The maximum number of practice lines, outlet lines, x-sections per line, and ground points per x-section are used to reduce memory requirements if you receive a "not enough memory" error. The available memory is checked when these values are entered. Different combinations can be entered. For example, you can reduce the number of practices to get more x-sections per line.

Maximum Number of Practice Lines : This should be the largest number of practice lines you will be designing. The maximum value you can enter is 10.

Maximum Number of Outlet Lines : Enter the most outlet lines you will be using. The maximum is 10.

Maximum Number of X-sections per Line : This value determines how many cross-sections you can have along a practice. The maximum number is 50.

Maximum Number of Ground Points per X-section : You can enter a value from 1 to 14 here to set the number of ground points that can be entered at a cross-section.

SCREEN 12 - X-Section Information

Screen 12 defines a default cross-section shape. The values defining the shape are used by the Design program (screen 8). Refer to 2 for the definitions used for these values. They are also discussed in the Design section under screen 8.

SCREEN 12

```
SCREEN #12

                        DEFAULT X-SECTION INFORMATION

                     FRONT CUT SLOPE WIDTH -----> 15   ft
                     CHANNEL BOTTOM WIDTH  ----->      ft
                         FRONT SLOPE WIDTH -----> 15   ft
                      RIDGE/DIKE TOP WIDTH ----->      ft
                          BACK SLOPE WIDTH ----->      ft
                      BACK CUT SLOPE WIDTH ----->      ft
                     RIDGE/DIKE BASE WIDTH ----->      ft
                     FRONT CUT SLOPE RATIO ----->
                         FRONT SLOPE RATIO ----->
                          BACK SLOPE RATIO -----> 5
                           X-SECTION SHAPE -----> 1

                             X-SECTION SHAPE CODES
    1- BROAD BASE       2- STEEP BACK       3- NARROW BASE      4- DIVERSION


          Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
         F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

SCREEN 13 - Inlet and Conduit Type Information

Default inlet and conduit information is entered on screen 13, shown below. This information is used in the Design program (screens 5 and 7).

SCREEN 13

```
SCREEN 13

                       DEFAULT INLET INFORMATION

                                INLET TYPE -----> 2
                                INLET SIZE -----> 5    in
                               INLET DEPTH -----> 3    ft
                             ORIFICE DEPTH ----->      ft

                               INLET TYPE CODES
    1 - MO-I            2 - MO-II           3 - NEBR            4 -

                DEFAULT CONDUIT TYPE INFORMATION

        ORIFICE FLOW CONTROL CONDUIT TYPE  -----> 1
        CONDUIT FLOW CONTROL CONDUIT TYPE  -----> 2

                               CONDUIT TYPE CODES
1 - PCPT     2 - CPT      3 - TILE     4 - PVC      5 - CMP      6 -


          Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
         F3-REPEAT ENTRY          F4-GO SCREEN          F10-STORE DATA
```

INLET TYPE : You can indicate the default inlet type to use for a design. The available types are listed near the center of the screen and were the ones defined on screen 8 above.

INLET SIZE : Enter the default size of the inlet in inches.

INLET DEPTH : Enter a default inlet depth in feet. Inlet depth is depicted in 4 on page 8.

ORIFICE DEPTH : Enter a value to use as default for orifice depth in feet. This depth is also illustrated in 4.

ORIFICE FLOW CONTROL CONDUIT TYPE : This will be the default used if the flow is orifice controlled. The choices are listed near the bottom of the screen and were defined on screen 2 above.

CONDUIT CONTROL CONDUIT TYPE : This will be the default used if the flow is controlled by the conduit. The choices are listed near the bottom of the screen and were defined on screen 2 above.

SCREEN 14 - Default Printed Data Selection

Screen 14, which is used to set the print defaults used in the Print/Plot program (screen 3), is divided into two sections. The first section is Data Selection, where you can specify which practices and outlets to print. The Printout Type Selection section determines what reports are printed for the selected practices and outlets. Simply enter an X in the appropriate fields. Selected practice and selected outlet, however, require values, such as 2 for the practice and C for the outlet. Press <*Delete*> to remove an X or a value. Refer to the Print/Plot section of this manual for a discussion of the different reports.

SCREEN 14

```
DEFAULT PRINTED DATA SELECTION            SCREEN #14

     DATA SELECTION
                     ALL PRACTICES ----> _
                     ALL   OUTLETS ----> X
                  SELECTED PRACTICE ---->
                   SELECTED  OUTLET ---->
     PRINTOUT TYPE SELECTION
                        COVER PAGE ----> X
                    PRACTICE GROUND ----> X
                      OUTLET GROUND ----> X
                    COMPLETE DESIGN ---->
                 ABBREVIATED DESIGN ----> X
            CHANNEL & RIDGE LAYOUT ---->
                 X-SECTION  LAYOUT ---->
            CONDUIT & INLET LAYOUT ---->
               DETAILED QUANTITIES ----> X
                  TOTAL QUANTITIES ----> X
             VERTICAL CONTROL DATA ----> X
           ENTER X OR THE REQUESTED VALUE NEXT TO DESIRED OUTPUTS


          Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
         F3-REPEAT ENTRY          F4-GO SCREEN         F10-STORE DATA
```

SCREEN 15 - Default Plotted Data Selection

Screen 15, which is used to set the plot defaults used in the Print/Plot program (screen 3), is divided into two sections also. The first section is Data Selection, where you can specify which practices and outlets to print. The Plot Type Selection section determines what items are plotted (displayed) on the screen and/or printed for the selected practices and outlets. Simply enter an X in the appropriate fields. Selected practice, selected outlet, profile horizontal scale, and selected x-sections (from station and to station), however, require values, such as 1 for the practice, A for the outlet, 100 for the scale, and 100 to 500 for the stations. Press <*Delete*> to remove an X or a value. Refer to the Print/Plot section of this manual for a detailed discussion of the options here.

SCREEN 15

```
DEFAULT PLOTTED DATA SELECTION            SCREEN #15

     DATA SELECTION
                        ALL PRACTICES ----> X
                        ALL   OUTLETS ----> X
                    SELECTED PRACTICE ---->
                     SELECTED  OUTLET ---->
     PLOT TYPE SELECTION
                      PRACTICE PROFILE ----> X
                        OUTLET PROFILE ----> X
                  SPOIL/BORROW PROFILE ----> X
          PROFILE HORIZ SCALE (FT/IN) ---->
           STANDARD TYPICAL X-SECTION ---->
              ALL PRACTICE X-SECTIONS ----> X
         SELECTED X-SECTIONS FROM STA ---->
                              TO STA ---->
                    ALLOW NOTE ENTRY ----> X
                VIEW WITHOUT PRINTING ---->

            ENTER X OR THE REQUESTED VALUE NEXT TO DESIRED OUTPUTS


          Esc-MAIN MENU        Pg Dn-NEXT SCREEN      Pg Up-PREV SCREEN
         F3-REPEAT ENTRY          F4-GO SCREEN         F10-STORE DATA
```

APPENDIX A - SAMPLE OUTPUT

This appendix shows sample printouts and plots from the Print/Plot Data program. The complete report is not shown, only a sample of each type of report. The data for this sample is contained in the four files: SAMPLE.GRD, SAMPLE.OGD, SAMPLE.VCD, and SAMPLE.DES . These can be used in learning the program and to obtain a complete report.

PRINTED OUTPUT

This section provides samples of the output selectable from screen 3 of the Print/Plot Data program.

If cover page is selected, a page similar to the one below is printed. The information printed here is essentially the data from screens 1 and 2 of the Print/Plot Data program.

COVER PAGE

```
                  ****************************************
                          TERRACE/DIVERSION  DATA
                  ****************************************


                    Landowner:  JOHN SMITH

                     Township:  26N

                        Range:  31W

                      Section:  12

                     Field No:  10

          Design Data Filename:  SAMPLE

 Practice Ground Data Filename:  SAMPLE

   Outlet Ground Data Filename:  SAMPLE

Vertical Control Data Filename:  SAMPLE

                  Designed by:  TOM KEEP

                         Date:  05-25-1990

                  Approved by:  _____________________

                         Date:  _____________


            PLANNED IN COOPERATION WITH BOONE COUNTY

                          555 VANDIVER
                          COLUMBIA
                          MO
                          65202
```

Samples of the practice and outlet ground data reports are shown below. This is the data that was entered in the Input Ground Data program. These would include all the practices and all the outlets if all data had been selected. If an HI is used, then the data printed will indicate foresights and distances (as shown in the practice report); otherwise, elevation and distance values will be printed (as in the outlet report).

PRACTICE GROUND

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
  COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                         SECTION: 12
  CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 1

                  **** PRACTICE LINE GROUND DATA ****

     STA     HI    (FS or ELEV)/DIST  ------>

    ***** PRACTICE LINE 2  *****
    0+00    91.0    5.0 / 0     4.0 / 30
    1+00    91.0    5.5 / 0     4.3 / 30
    2+00    91.0    6.5 / 0     5.3 / 30
    3+00    91.0    7.0 / 0     6.2 / 30
    4+00    91.0    8.0 / 0     6.8 / 30
    5+00    91.0    8.5 / 0     7.2 / 30
    6+00    91.0    9.0 / 0     7.8 / 30
    7+00    91.0    7.5 / 0     6.3 / 30
    8+00    91.0    7.0 / 0     5.8 / 30
    9+00    91.0    6.2 / 0     5.0 / 30
   10+00    91.0    5.5 / 0     4.8 / 30
   11+00    91.0    6.5 / 0     5.5 / 30
   12+00    91.0    7.2 / 0     6.0 / 30
   13+00    91.0    8.0 / 0     7.0 / 30
   14+00    91.0    7.3 / 0     6.5 / 30
   15+00    91.0    6.5 / 0     6.0 / 30
```

OUTLET GROUND

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
  COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                         SECTION: 12
  CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 2

                   **** OUTLET LINE GROUND DATA ****

     STA     HI    (FS or ELEV)/DIST  ------>

   ***** OUTLET LINE A *****
    0+00           90.0 / 0
    0+50           87.0 / 0
    1+00           85.1 / 0
    1+50           82.0 / 0
    2+00           80.1 / 0
    2+50           77.1 / 0
    3+00           73.0 / 0
    3+20           72.0 / 0
    3+50           70.0 / 0
    4+00           68.2 / 0
    4+50           67.0 / 0
    4+60           61.0 / 0
    4+64           61.0 / 0
    4+70           66.5 / 0
```

Selecting Complete Design will provide a detailed report of the design. The information printed is from the Design program. For more information concerning the values, you should refer to the section discussing the Design program. A sample of this report is shown in the following three figures.

The first figure shown below contains the sections: watershed information (screen 2); outlet location information (screen 3); outlet type, end and junction information (screen 4); inlet information (screen 5); and outlet gradeline information (screen 6).

COMPLETE DESIGN (FIRST PAGE)

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
PREPARED BY: TOM KEEP                         SECTION: 12
CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 3

         ***************  WATERSHED INFORMATION  ***************

                 DESIGN STORM FREQ. 10    RAINFALL DEPTH (IN) 5

 FROM     TO      AVE.     WSHED      AVE.    SOILLOSS   RUNOFF    RUNOFF
 STA.    STA.   WIDTH FT  AREA AC   SLOPE %   TONS/AC   CURVE NO  DEPTH IN
 Line No  2  ------------------------------------------------------------
 0+00    5+00   120        1.38      6.0        5.0       75        2.45
 5+00   10+00   150        1.72      4.0        5.0       75        2.45
10+00   15+00   120        1.38      4.0        5.0       75        2.45


           *************  OUTLET LOCATION INFORMATION  *************

 FROM     TO    OUTLET    PRACT   OUTLET   OUTLET   OUTLET    WSHED   RUNOFF
 STA.    STA.     ID      STA.     STA.     ELEV    C/F FT   AREA AC  VOL ACF
 Line No  2  ------------------------------------------------------------
 0+00    10+00     A      6+00      1+50    82.0      0.0      3.10    0.63
10+00    15+00     B     13+00      0+00    82.0     -1.0      1.38    0.28


         *******  OUTLET TYPE, END & JUNCTION INFORMATION  *******

 OUTLET    OUTLET    END      END       T.W.      JCT.      JCT.     WSHED
   ID       TYPE     STA.     ELEV.     ELEV.      ID       STA.      AREA

   A        UGO      4+60     62.5      66.0                          9.98
   B        WW       3+60     60.5                                    3.45


         ******************  INLET INFORMATION  ******************

OUTLET    INLET     INLET     INLET        INLET      ORIFICE     ORIFICE
 STA.      ID       TYPE      SIZE         DEPTH-FT   DEPTH-FT     DIA-IN
 Outlet  A  ---------------------------------------------------------------
 0+00      A1       MO-I        6           3.0
 1+50      A2       MO-I       10           3.0
 3+00      A3       MO-I       12           3.0


         *************  OUTLET GRADELINE INFORMATION  *************

 REACH   |----  FROM ----|         |----   TO  ----|       PERCENT
  NO.    STA.   ELEV   C/F         STA.    ELEV  C/F        GRADE
 Outlet A ------------------------------------------------------------
  1      0+00   87.0  -3.0         1+50    79.0  -3.0       5.33
```

The complete design report continues with the sections: outlet design information (screen 7); design x-section information (screen 8); channel gradeline information (screen 9); and channel design information (screen 10).

COMPLETE DESIGN (SECOND PAGE)

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
PREPARED BY: TOM KEEP                         SECTION: 12
CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 4

         *************  OUTLET GRADELINE INFORMATION  *************

 REACH   |----  FROM ----|         |----   TO  ----|       PERCENT
  NO.    STA.   ELEV   C/F         STA.    ELEV  C/F        GRADE
 OUTLET A ------------------------------------------------------------------
  2      1+50   79.0  -3.0         3+00    70.0  -3.0       6.00
  3      3+00   70.0  -3.0         4+60    62.5   1.5       4.69


         *************  OUTLET  DESIGN  INFORMATION  *************

 FROM    TO     ACCUM    INFLOW    INFLOW   COND  REL.  COND   REQD    COND
 STA     STA     DA      POINT     CONTROL  TYPE  TIME  SIZE   CFS     CAP
 Outlet A ------------------------------------------------------------------
 0+00    1+50     3.4   INLT A1    CONDUIT  CPT   28.2    4    0.356   0.356
 1+50    3+00     6.5   INLT A2    CONDUIT  CPT   10.8    6    1.064   1.064
 3+00    4+60    10.0   INLT A3    CONDUIT  CPT    9.3    8    2.138   2.138


           ************  DESIGN  X-SECTION  INFORMATION  ***********

 FROM    TO     FCS   BOT    FS   TOP   BS    BCS   BASE  FCS   FS   BS  XSEC
 STA     STA    WDTH  WDTH  WDTH  WDTH  WDTH  WDTH  WDTH   Z    Z    Z  SHAPE

 Line No  2  ---------------------------------------------------------------
 0+00   15+00         8.0  15.0   3.0                    5.0       5.0    1


                        X-SECTION SHAPE CODES
 1 - BROAD BASE   2 - STEEP BACK      3 - NARROW BASE     4 - DIVERSION


         *************  CHANNEL GRADELINE INFORMATION  ************

  REACH   |----  FROM ----|         |----   TO  ----|       PERCENT
   NO.    STA.   ELEV   C/F         STA.    ELEV  C/F        GRADE
 Line No  2  ---------------------------------------------------------------
   1      0+00   86.0   0.0         6+00    82.0   0.0       0.67
   2      6+00   82.0   0.0        10+00    85.5   0.0       0.88
   3     10+00   85.5   0.0        13+00    82.0  -1.0       1.17
   4     13+00   82.0  -1.0        15+00    84.5   0.0       1.25


          ***********  CHANNEL  DESIGN  INFORMATION  **********

  FROM    TO      DESIGN   LINING   EROSION   MAX ALLOW  STABILITY  CAPACITY
  STA     STA     Qp-CFS    TYPE     RESIST    VEL-FPS    VEL-FPS   DEPTH-FT
Line No  2  ---------------------------------------------------------------
  0+00    6+00      5.2     EARTH    AVERAGE     2.0        1.5        0.5
```

The final figure below contains the sections: storage pool design information (part of screen 11 plus some additional values) and earthwork information by outlet reach (screen 11).

COMPLETE DESIGN (THIRD PAGE)

```
BOONE COUNTY                                  PREPARED FOR: JOHN  SMITH
  COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                         SECTION: 12
  CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 5

           ***********  CHANNEL  DESIGN  INFORMATION  **********

   FROM     TO      DESIGN   LINING   EROSION   MAX ALLOW  STABILITY  CAPACITY
   STA      STA     Qp-CFS    TYPE     RESIST    VEL-FPS    VEL-FPS   DEPTH-FT
 Line No  2  ------------------------------------------------------------------
   6+00    10+00      4.5     EARTH    AVERAGE     2.0        1.6        0.4
  10+00    13+00      2.9     EARTH    AVERAGE     2.0        1.5        0.3
  13+00    15+00      2.0     EARTH    AVERAGE     2.0        1.4        0.2


           **********  STORAGE POOL DESIGN INFORMATION  **********

                   DESIGN STORM FREQ. 10    RAINFALL DEPTH (IN) 5

                            WSHED  RUNOFF FLOOD   SED.  POOL   REL.  REL.  POOL
 FROM  TO  OUTLET  OUTLET   AREA   VOL    VOL    VOL    VOL   RATE  TIME  DEPTH
 STA   STA    ID     STA     AC    ACF    ACF    ACF    ACF   CFS   HRS    FT
 Line No  2  ------------------------------------------------------------------
 0+00  10+00   A    6+00    3.1   0.63   0.32   0.06   0.38   0.706 10.8   2.1
10+00  15+00   B   13+00    1.4   0.28          0.03


           ***********  EARTHWORK INFORMATION BY OUTLET REACH **********

                            CUT/FILL DENSITY RATIO =  1

                     C/F      CUT     FILL   BORROW   SPOIL
  FROM   TO  OUTLET   BAL.     VOL.    VOL.    VOL.    VOL.
  STA   STA    ID    METHOD    CYDS.   CYDS.   CYDS.   CYDS.
 Line No  2  ------------------------------------------------
  0+00  10+00   A       1        55    1236    1182       0
 10+00  15+00   B       1       117     704     586       0


                CUT/FILL BALANCE ADJUSTMENT METHOD CODES
 1-NONE    2-CHANNEL ELEV    3 - BCSW @ EACH X-SEC    4 - BCSW @ SELECT X-SEC
```

The abbreviated design option gives you a condensed version of the design as shown below.

ABBREVIATED DESIGN

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
  COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                         SECTION: 12
  CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 6

           **********  ABBREVIATED PRACTICE INFORMATION  **********

                   DESIGN STORM FREQ. 10    RAINFALL DEPTH (IN) 5

                            WSHED  RUNOFF STORAGE SEDIMENT POOL RELEASE RELEASE
 FROM  TO  OUTLET  PRACT    AREA   VOL     VOL     VOL      VOL    RATE    TIME
  STA  STA    ID     STA     AC    ACF     ACF     ACF      ACF    CFS     HRS
 Line No  2  ------------------------------------------------------------------
 0+00  10+00   A    6+00   3.1    0.63    0.32    0.06     0.38   0.706   10.8
10+00  15+00   B   13+00   1.4    0.28            0.03


           *************  ABBREVIATED OUTLET INFORMATION  *************

 |-- FROM --|    |--- TO ---|    INFLOW   ACCUM   COND   COND   REQD   COND
 STA     ELEV    STA     ELEV    POINT     DA     TYPE   SIZE   CFS    CAP
  OUTLET A ------------------------------------------------------------------
 0+00    87.0    1+50    79.0    INLT A1   3.44    CPT     4    0.356  0.356
 1+50    79.0    3+00    70.0    INLT A2   6.54    CPT     6    1.064  1.064
 3+00    70.0    4+60    62.5    INLT A3   9.98    CPT     8    2.138  2.138


           ************  ABBREVIATED INLET INFORMATION  ************

 OUTLET    INLET     INLET     INLET        INLET      ORIFICE     ORIFICE
  STA.      ID       TYPE      SIZE         DEPTH-FT   DEPTH-FT     DIA-IN
  Outlet  A  ---------------------------------------------------------------
  0+00      A1       MO-I        6            3.0
  1+50      A2       MO-I       10            3.0
  3+00      A3       MO-I       12            3.0
```

The channel and ridge layout report, shown below, is a worksheet used to assist in the actual layout and checkout of the channel and ridge. You should first determine the elevation of your instrument sightline and record that in the H.I. column. The grade rod can then be computed by taking your H.I. minus planned elevation. The channel or ridge error is then determined by subtracting the actual rod reading from the calculated grade rod.

CHANNEL & RIDGE LAYOUT

BOONE COUNTY — PREPARED FOR: JOHN SMITH
COLUMBIA MO — TWP: 26N RANGE: 31W
PREPARED BY: TOM KEEP — SECTION: 12
CHECKED BY:_____ DATE:_____ — FIELD NO: 10 — PAGE 7

********** CHANNEL AND RIDGE LAYOUT/CHECKOUT INFORMATION **********

PRACTICE LINE NO. 2 Baseline (Flagline) to Channel CL Offset = 0
OUTLET STATION A = 6+00 B = 13+00

		CHANNEL					RIDGE				
Sta.	H.I.	*BL-CL * Cut/ Fill	Plan Chan. Elev.	Chan. Grade Rod	Act. Chan. Rod	Chan.* Error +/- *	Plan Ridge Ht.	Plan Ridge Elev.	Ridge Grade Rod	Act. Ridge Rod	Ridge Error +/-
0+00		* 0.0	86.0			*	1.1	87.1			
1+00		* -0.2	85.3			*	1.1	86.4			
2+00		* 0.2	84.7			*	1.1	85.8			
3+00		* 0.0	84.0			*	1.1	85.1			
4+00		* 0.3	83.3			*	1.1	84.4			
5+00		* 0.2	82.7			*	1.5	84.2			
6+00		* 0.0	82.0			*	2.2	84.2			
7+00		* -0.6	82.9			*	1.2	84.1			
8+00		* -0.2	83.8			*	1.0	84.8			
9+00		* -0.2	84.6			*	1.1	85.7			
10+00		* 0.0	85.5			*	1.1	86.6			
11+00		* -0.2	84.3			*	1.1	85.4			
12+00		* -0.6	83.2			*	1.0	84.2			
13+00		* -1.0	82.0			*	1.0	83.0			
14+00		* -0.5	83.3			*	1.1	84.3			
15+00		* 0.0	84.5			*	1.1	85.6			
		*				*					
		*				*					
		*				*					
		*				*					
		*				*					

H.I. = Elev of instrument sightline
Grade Rod = H.I. - Planned Elev.
Chan/Ridge error = Grade Rod - Actual Chan/Ridge Rod
Plan Ridge Elev. = Design Ridge Elev. + Settlement Allowance
Plan Ridge Ht. = Planned Ridge Elev. - Planned Channel Elev.
BL-CL Cut/Fill = Planned Channel Elev. - Ground Elev. @ Baseline (Flagline)

The x-section layout report is illustrated below. Most of the dimensions in this printout are illustrated in 2 on page 6. Near the bottom is a worksheet to be used to checkout a cross-section at a particular station. Some notes concerning slope width measurement points is given at the bottom. These are also discussed in the section on station conventions.

X-SECTION LAYOUT (PARTIAL)

SOIL CONSERVATION SERVICE — PREPARED FOR: JOHN SMITH
TWP: 26N RANGE: 31W
PREPARED BY: TOM KEEP — SECTION: 12
CHECKED BY:_____ DATE:_____ — FIELD NO: 10 — PAGE 8

**************** X - SECTION LAYOUT INFORMATION ****************

PRACTICE LINE NO. 2 Baseline (Flagline) to Channel CL Offset = 0

	SLOPE RATIOS				X - SECTION WIDTHS					
Sta.	F.Cut Slope Z	Front Slope Z	Back Slope Z	Front Ct Slp Width	Chan Botm Width	Front Slope Width	Ridge Top Width	Back Slope Width	Back Ct Slp Width	Sto. Pool Width
0+00	5.0	15.0	5.0	1.0	8.0	15.0	3.0	11.7		
1+00	5.0	15.0	5.0	2.0	8.0	15.0	3.0	10.7		
2+00		15.0	5.0	0.2	8.0	15.0	3.0	12.8		
3+00	5.0	15.0	5.0	0.6	8.0	15.0	3.0	9.2		9.2
4+00		15.0	5.0	4.3	8.0	15.0	3.0	13.8		41.5
5+00	5.0	10.8	5.0	0.0	8.0	15.0	3.0	16.1		55.0
6+00	5.0	7.3	5.0	1.0	8.0	15.0	3.0	18.4		70.5
7+00	5.0	12.6	5.0	4.9	8.0	15.0	3.0	9.0		33.0
8+00	5.0	15.0	5.0	2.6	8.0	15.0	3.0	10.2		14.2
9+00	5.0	15.0	5.0	2.1	8.0	15.0	3.0	10.7		
10+00	5.0	15.0	5.0	0.5	8.0	15.0	3.0	8.6		
11+00	5.0	15.0	5.0	1.8	8.0	15.0	3.0	9.4		
12+00	5.0	15.0	5.0	5.0	8.0	15.0	3.0	7.8		
13+00	5.0	15.0	5.0	6.8	8.0	15.0	3.0	4.4		
14+00	5.0	15.0	5.0	3.2	8.0	15.0	3.0	6.6		

************ X - SECTION CHECKOUT @ STATION _____ ************

F.S. DIST	Back Ct Slp @ Grd	Back Slope @ Toe	Ridge @ Top Width	Ridge @ C.L.	Ridge @ Top Width	Chan @ Bot Width	Chan @ C.L.	Chan @ Bot Width	Front Slope @ Grd
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Slope Width Measurement Points : 1. CL of Ridge if Top Width <= 3
2. Edge of Top Width if Top Width > 3
3. CL of Channel if Bottom Width <= 3
4. Edge of Channel if Bottom Width > 3

Sto. Pool Width = Storage Pool Width @ Design Pool Elevation

The layout and checkout information for conduits and inlets is printed as shown below. This is a worksheet that is completed the same as explained earlier for the channel and ridge layout worksheet.

CONDUIT & INLET LAYOUT

BOONE COUNTY — PREPARED FOR: JOHN SMITH
COLUMBIA MO — TWP: 26N RANGE: 31W
PREPARED BY: TOM KEEP — SECTION: 12
CHECKED BY:_____ DATE:_____ — FIELD NO: 10 — PAGE 10

********** CONDUIT AND INLET LAYOUT/CHECKOUT INFORMATION **********

CONDUIT A Baseline (Flagline) to Conduit CL Offset = 0

		CONDUIT				INLET			
Sta.	H.I.	Cond Cut/ Fill	Plan Cond. Elev.	Cond. Grade Rod	Act. Cond. Rod	Cond. Error +/-	Plan Inlet Depth	Plan Inlet Elev.	Inlet Grade Rod	Act. Inlet Rod	Inlet Error +/-
0+00		-3.0	87.0				3.0	90.0			
1+50		-3.0	79.0				3.0	82.0			
3+00		-3.0	70.0				3.0	73.0			
4+60		1.5	62.5								

H.I. = Elev of instrument sightline
Grade Rod = H.I. - Planned Elev.
Cond/Inlet error = Grade Rod - Actual Cond/Inlet Rod
Plan Inlet Elev. = Planned Channel Elev. @ Inlet (Inlet Flowline)
Plan Inlet Depth. = Planned Inlet Elev. - Planned Conduit Elev.
Cond Cut/Fill = Planned Conduit Invert Elev. - Ground Elev. @ Conduit CL.

Various quantities are printed for each practice and each outlet in the detailed quantities report. The values given are shown below.

DETAILED QUANTITIES

```
BOONE COUNTY                                    PREPARED FOR: JOHN SMITH
  COLUMBIA  MO                                    TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                           SECTION: 12
  CHECKED  BY:_________________ DATE:_________    FIELD NO: 10          PAGE 11

           *********  EARTHWORK QUANTITIES BY PRACTICE  *********

   CUT/FILL DENSITY RATIO =  1

   FROM     TO    CUT VOL   FILL VOL   SPOIL VOL   BORROW VOL
   STA.    STA.     CYD.      CYD.        CYD.        CYD.
   Line No  2  ------------------------------------------------------------
   0+00     10+00      55     1236            0        1182
  10+00     15+00     117      704            0         586

           ***********  CONDUIT QUANTITIES BY OUTLET ************

   FROM     TO      CONDUIT       CONDUIT         CONDUIT
   STA.    STA.      TYPE       LENGTH (FT)      SIZE (IN)
   Outlet A ----------------------------------------------------------
   0+00    1+50      CPT            150              4
   1+50    3+00      CPT            150              6
   3+00    4+50      CPT            150              8
   4+50    4+60   OUTLET PIPE        10              8

           ***********  INLET QUANTITIES BY OUTLET   ************

  OUTLET   INLET   INLET     INLET      INLET        ORIFICE     INLET
   STA.     ID     TYPE    SIZE (IN)   DEPTH (FT)   SIZE (IN)   TEE SIZE
   Outlet A ----------------------------------------------------------
   0+00     A1     MO-I        6          3.0          NA       4 X 6
   1+50     A2     MO-I       10          3.0          NA       4 X 6 X10
   3+00     A3     MO-I       12          3.0          NA       6 X 8 X12

           ***********   SEEDING AREA BY PRACTICE   *************

  PRACTICE     FROM     TO     SEEDING AREA
    LINE       STA.     STA.      ACRES
     2         0+00     15+00    NA
```

The total quantities printout summarizes the quantity figures for all practices and all outlets. The printout appears as below.

TOTAL QUANTITIES

```
BOONE COUNTY                                  PREPARED FOR: JOHN SMITH
  COLUMBIA  MO                                  TWP: 26N  RANGE: 31W
  PREPARED BY: TOM KEEP                         SECTION: 12
  CHECKED  BY:_________________ DATE:________   FIELD NO: 10          PAGE 12

          **********  TOTAL TERRACE/DIVERSION LENGTH **********

              TOTAL LENGTH (FEET)  1500

          ************  TOTAL EARTHWORK QUANTITIES  ************

             CUT VOL     FILL VOL     SPOIL VOL     BORROW VOL
               CYD.         CYD.          CYD.          CYD.
                 172         1940             0           1768

          *************  TOTAL CONDUIT QUANTITIES  *************

                CONDUIT       CONDUIT         CONDUIT
                 TYPE        SIZE (IN)      LENGTH (FT)

                 CPT             4              150
                 CPT             6              150
                 CPT             8              150

          ***********  TOTAL OUTLET PIPE QUANTITIES  ***********

                PIPE          PIPE          PIPE
             LENGTH (FT)     SIZE (IN)     QUANTITY

                 10              8             1

          **************  TOTAL INLET QUANTITIES  **************

                INLET         INLET         INLET
                TYPE        SIZE (IN)      QUANTITY

                 MO-I            6             1
                 MO-I           10             1
                 MO-I           12             1

          ***************  TOTAL SEEDING AREA   ***************

              TOTAL SEEDING AREA (ACRES)   0.0
```

Any vertical control data and notes entered in the Input Ground Data program are printed here.

VERTICAL CONTROL DATA

BOONE COUNTY
COLUMBIA MO
PREPARED BY: TOM KEEP
CHECKED BY:_____ DATE:_____

PREPARED FOR: JOHN SMITH
TWP: 26N RANGE: 31W
SECTION: 12
FIELD NO: 10 PAGE 13

DESIGN/CHECKOUT VERTICAL CONTROL DATA SHEET 1

STA.	B.S.	H.I.	F.S.	ELEV.	Bench Mark Descriptions & Notes
TBM#1	2.31	102.31		100.0	Top of lower gate hinge pin in sw corner of field 10
TP#1	2.11	97.69	6.73	95.58	
HUB#1	2.01	94.06	5.64	92.05	LAYOUT HUB FOR TERRACE #1 @ STA 4+50
HUB#2	2.34	86.06	10.34	83.72	LAYOUT HUB FOR TERRACE #2 @ STA 6+00
HUB#3	14.56	89.49	11.13	74.93	LAYOUT HUB FOR TERRACE #3 @ STA 6+00
TP#2	15.67	103.11	2.05	87.44	
TBM#1			3.08	100.03	CLOSURE ERROR = 0.03 FT

PLOTTED OUTPUT

This section provides samples of the plots selectable from screen 4 of the Print/Plot Data program. The samples are shown on the following pages.

PRACTICE PROFILE

The first two samples below show a practice profile plot during the process of entering a note. The first sample shows the window that appears for you to enter your note. After entering a note, you can move it around with your arrow keys. After it is positioned, you press <*Enter*>. The note is then secured there. The second sample below shows the profile with the note placed.

The channel centerline is indicated with a dotted line and the constructed ridge by a solid line. The ground at the channel centerline is shown by a short dashed line. If there is a pool, it is shown by a long dashed line.

OUTLET PROFILE

The outlet profile is shown for outlet A. When the scale used does not allow the whole profile to be plotted, the drawing is extended to another sheet, as noted by "Sheet 1 of 2" in the example. The second sheet is not shown here. The outlet flowline is depicted by a solid line, while the ground at the outlet centerline is shown with a dashed line.

SPOIL/BORROW PROFILE

The spoil/borrow balance shows a profile of spoil available or borrow required. Anything above the zero axis is spoil and anything below is borrow. In the example shown, it is almost all borrow. These values are displayed in cubic yards per foot.

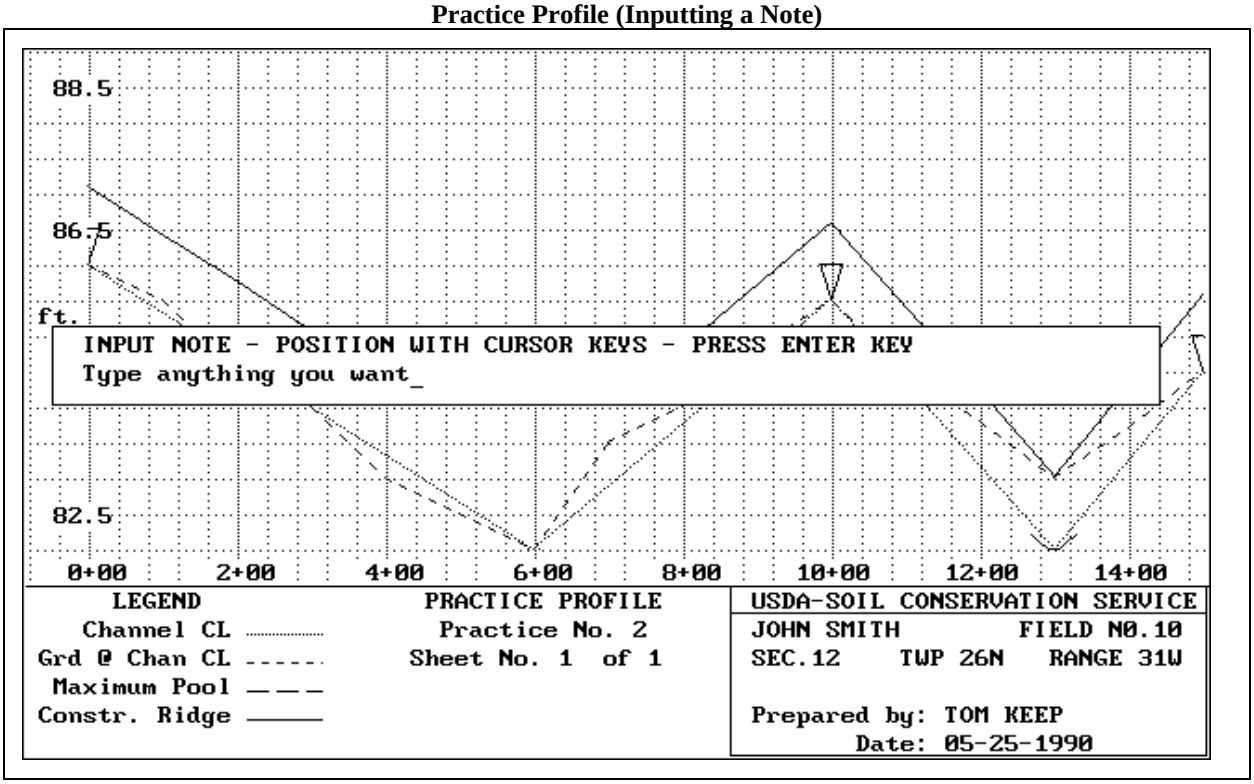
STANDARD TYPICAL X-SECTION

The typical cross-section plot illustrates the various dimensions used in a cross-section. The original ground line is depicted with a dash-dotted line. Any earthfill is shown with a solid line and excavation is shown with a dotted line.

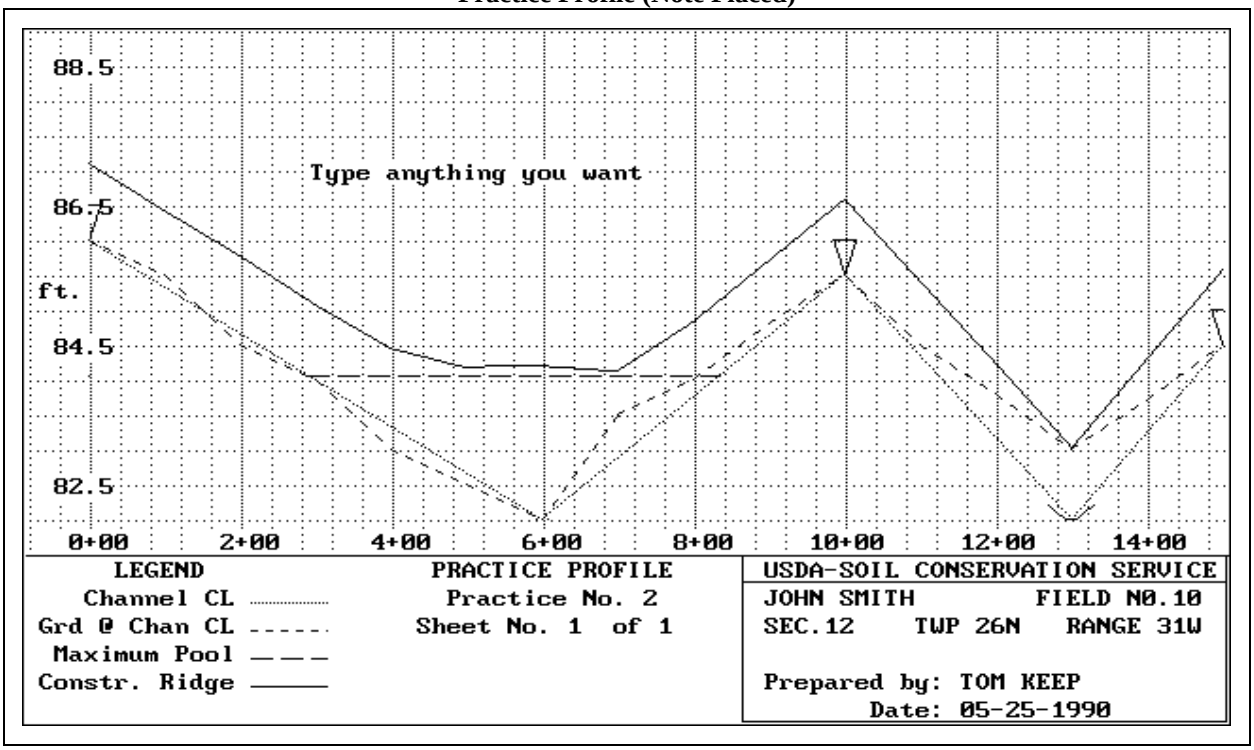
TERRACE X-SECTION

The plot of a terrace cross-section uses a solid line to represent the x-section, a dashed line to represent existing ground, and a dotted line to show ground that was extrapolated from the existing data. If there is a pool, that is indicated. The values for pool, cut, and fill areas are displayed in square feet.

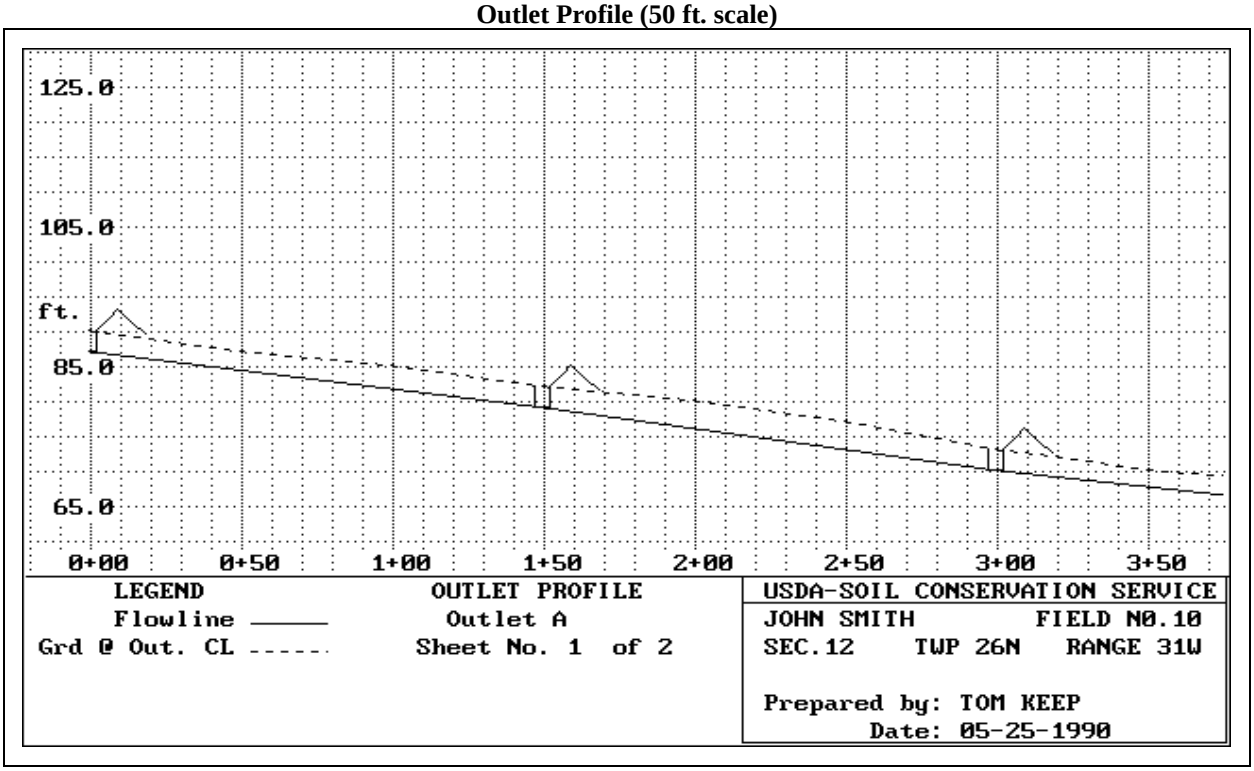
Practice Profile (Inputting a Note)



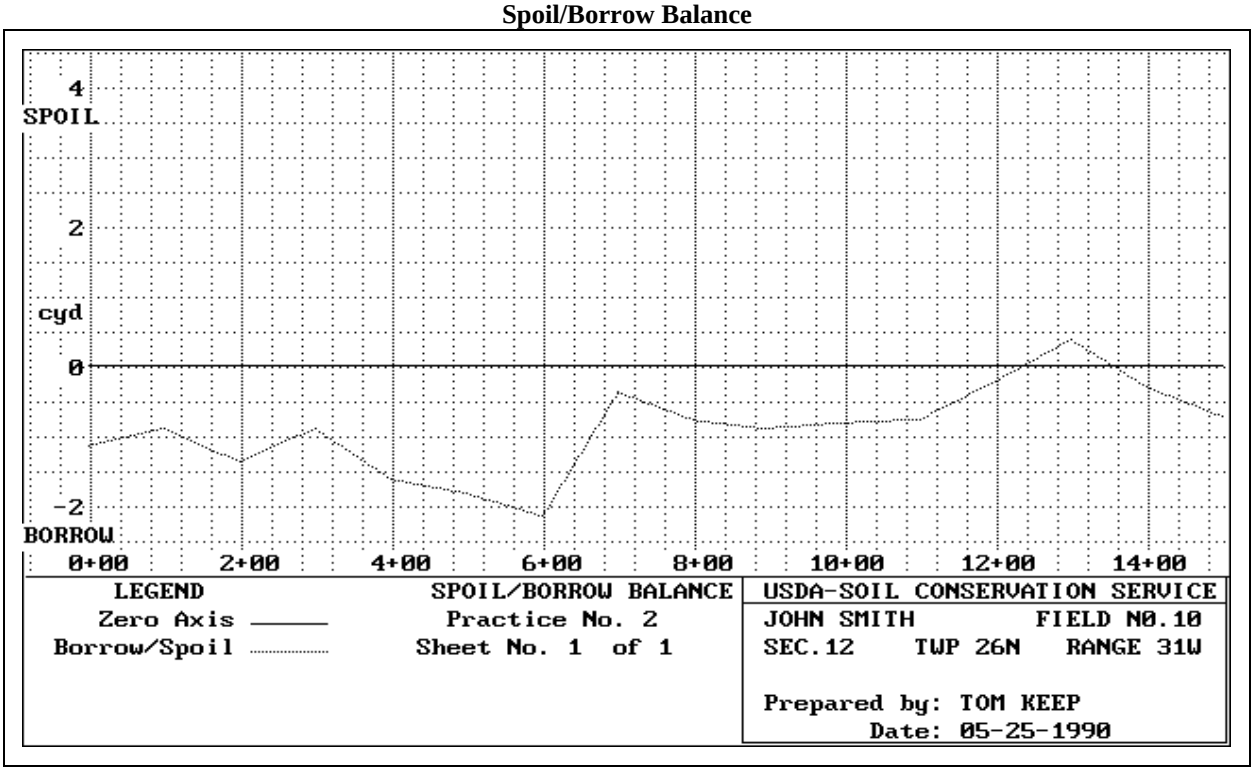
Practice Profile (Note Placed)



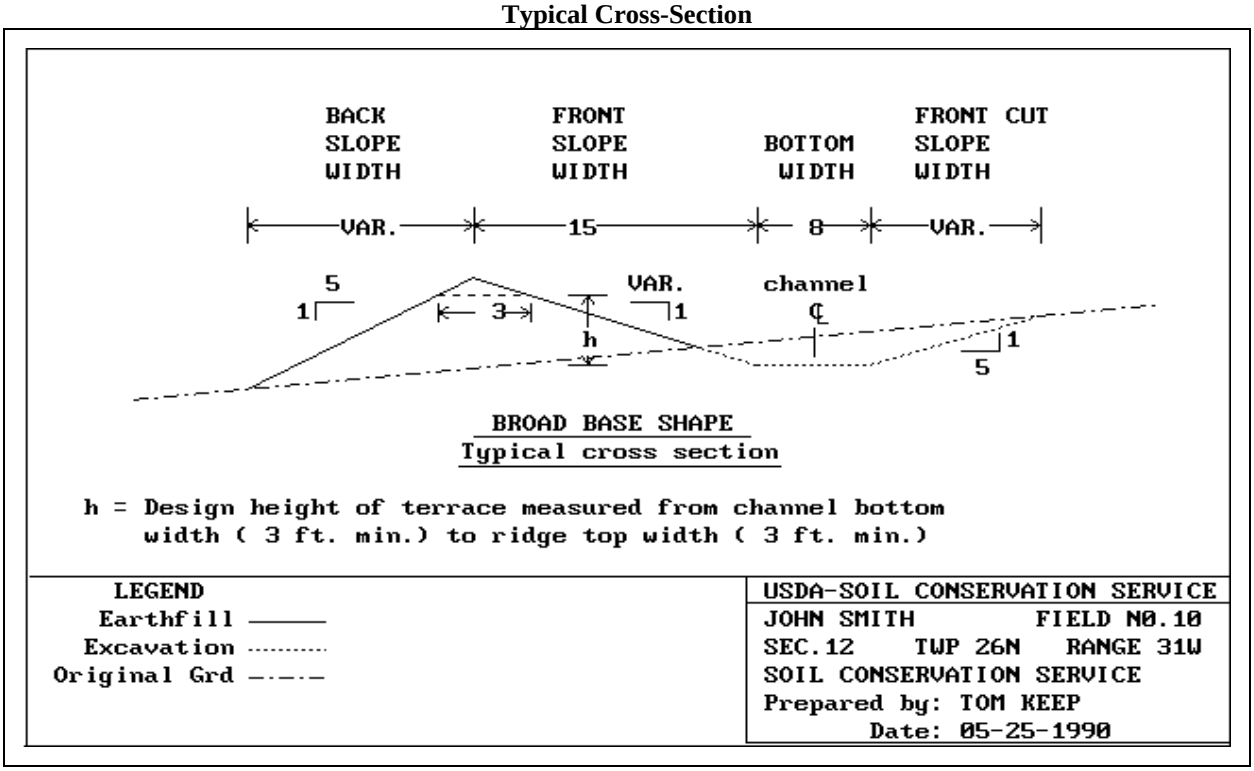
Outlet Profile (50 ft. scale)



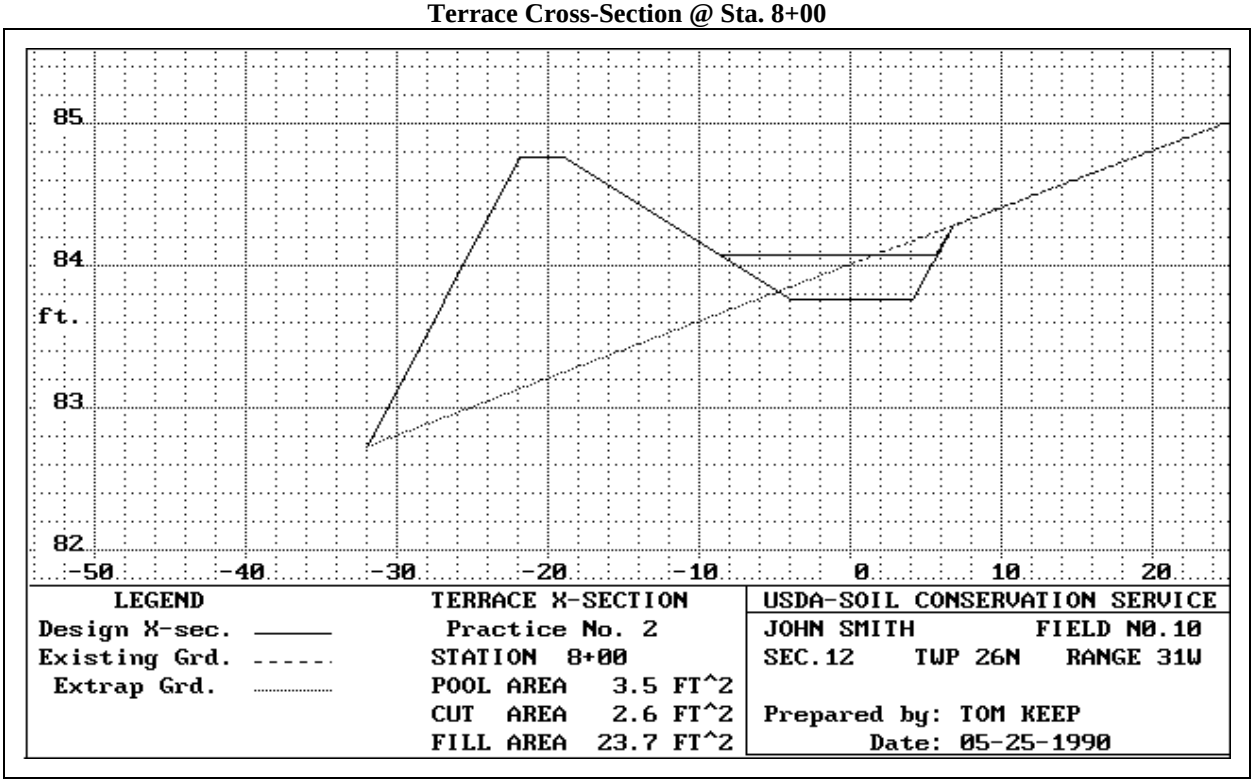
Spoil/Borrow Balance



Typical Cross-Section



Terrace Cross-Section @ Sta. 8+00



APPENDIX B - ERROR MESSAGES

This section is divided into general messages, messages pertaining to the Input Ground Data program, messages pertaining to the Terrace/Diversion Design program, and messages pertaining to the Print/Plot Data program. Within each category, the error messages are listed by screen, if applicable, and then alphabetically.

GENERAL ERROR MESSAGES

The errors listed below pertain to more than one of the programs. Most of them are hardware related.

BAD FILENAME : A filename you entered is invalid (e.g., invalid characters or name is too long). Try entering the name again.

COMPUTER IS NOT COMPATIBLE WITH REQUIRED GRAPHICS : You must have a CGA adapter (or one that supports CGA) or an AT&T display adapter to run the program. This error will most likely occur if you have a monochrome adapter and display.

DEVICE I/O ERROR : An input or output error occurred while the program was using a device, such as a printer or disk drive.

DEVICE UNAVAILABLE : The device (e.g., printer or disk drive) you are attempting to access is not online or does not exist.

DISK IS FULL : No more room exists on the disk that you are trying to save to. The solution is to save to another disk.

DISK IS WRITE PROTECTED : The write protect notch (for 5-1/4" disks) is covered or the hole (for 3-1/2" disks) is open. In order to write to the disk, you will need to uncover the notch or close the hole.

DISK MEDIA ERROR : A flaw was detected on the diskette. You will need to use a different diskette.

DISK NOT READY : There is no disk in the drive or the drive door is open.

ERROR # PRESS ANY KEY TO CONTINUE : A system error, not handled by the program, occurred. The "#" given refers to the error number listed in the BASIC manual. The process that was occurring when this error happens may not have completed (e.g., some calculations may not have been performed that normally are).

FILE NOT FOUND : The filename you entered could not be found in the drive and path that you specified. The cause could be an invalid drive:\path\, a mistyped filename, or the file is on another diskette or in a different directory. Pressing *<F2>* while on the filename field will list the files in the drive:\path\ . If you get this message when pressing *<F2>*, the drive:\path\ does not exist.

PATH FILE ACCESS ERROR : Either the drive:\path\ was invalid or you are trying to save to an existing read-only file. Check the drive:\path\ . If it is correct, try using another filename.

PATH NOT FOUND : Check the drive:\path\ to make sure it is correct.

TOO MANY FILES : This is the result of too many files attempting to be created in the root directory of the disk.

******* WARNING *******
PROGRAM SET FOR : # PRACTICES, # OUTLETS, # X-SECTIONS, # X-SEC POINTS
EXISTING DESIGN DATA CONTAINS : # PRACTICES, # OUTLETS, # X-SECTIONS
PRACTICE GROUND DATA CONTAINS : # PRACTICES, # X-SECTIONS, # X-SEC POINTS
OUTLET GROUND DATA CONTAINS : # OUTLETS, # X-SECTIONS, # X-SEC POINTS
******* EXCESS DATA WAS NOT READ INTO THE PROGRAM *******

The above warning message will appear if you try to load a data file that contains more data than you currently have your program set to handle. These limits can be increased on screen 11 of the Change Default Data program if your computer has enough memory. The "PROGRAM SET FOR ..." line will always be displayed. The following three lines will only appear if the specific data file is over the limits set. The data up to the limits is still loaded and is available for editing. Note, that if you save the data to the same filename, the extra data that was not loaded will be lost.

YOUR DATA IS NOT STORED PRESS 'Y' TO CONTINUE OR ANY OTHER TO CANCEL : You pressed *<Esc>* to exit the program and you have data that has not been saved. You can type 'Y' to exit the program without saving the data or any other key to return to the program so that you can save the data.

INPUT GROUND DATA ERROR MESSAGES

Input Ground Data	**SCREEN 1**

DATA TYPE CODE MUST BE 1 OR 2 : You must enter a 1 for ridge and channel data or a 2 for outlet data. No other value is allowed.

DATA TYPE CODE MUST BE ENTERED BEFORE PROCEEDING! : The data type code cannot be left blank. It must be a 1 or 2 (see above).

Input Ground Data	**SCREEN 3**

CAN NOT HAVE TWO ELEVATIONS AT THE SAME DISTANCE : Two points (foresights or elevations) cannot have the same distance. This would be ambiguous since one point could not have two elevations.

STATION HAS ALREADY BEEN ENTERED : This message will appear if you try to enter data for a station that already has data.

YOU CANNOT DELETE THE LAST POINT (OCCURS WITH DELETE KEY NOT F9 KEY) : You cannot delete a lone data point for a station using <*Delete*>. A station must have at least one data point. If you wish to delete the station, use <*F9*>.

TERRACE/DIVERSION DESIGN ERROR MESSAGES

Terrace/Diversion Design	**SCREEN 2**

% SLOPE MUST BE >= 0 : A positive average slope must be entered.

% SLOPE MUST BE <= 50 : Enter an average watershed slope less than or equal to 50.

MAXIMUM OF 10 WATERSHED REACHES ALLOWED : You cannot enter more than 10 watershed reaches.

NO INPUT ALLOWED WITHOUT PROFILE DATA : If you have not entered filenames and you try to enter anything on this screen, you will get this message.

NO PRACTICE GROUND DATA AVAILABLE : No practice ground data is currently loaded. This could occur if you have not entered the "TER/DIV GROUND FILENAME" or if the filename you entered contained no data.

RUNOFF CURVE NUMBER TOO LOW : The runoff curve number you entered is less than the curve number which results in a runoff depth of 0. Try entering a larger number.

TO STATION MUST BE > FROM STATION : The TO STATION must be larger than the FROM STATION. In other words, you must define the reaches in an increasing manner.

TO STATION MUST BE <= TO MAX PROFILE STATION : You cannot enter a station beyond the last station of your profile data.

Terrace/Diversion Design	**SCREEN 3**

ELEVATION MUST BE > 0 : A positive outlet elevation must be entered.

EXCEEDS MAXIMUM NUMBER OF PRACTICE JUNCTIONS ALLOWED PER OUTLET : An outlet can only intersect up to a certain number of practices. You have used the same outlet on more than this number of practices. This number is the maximum number of practice lines on screen 11 of the Change Default Data program.

NO INPUT ALLOWED WITHOUT PROFILE DATA : See same message under Screen 2 above.

NO PRACTICE GROUND DATA AVAILABLE : See same message under Screen 2 above.

OUTLET ID CAN NOT BE REPEATED ON SAME TER/DIV : An outlet cannot be used more than once on a practice.

OUTLET ID MUST BE A LETTER FROM A TO x : The ID must be a letter, not a number. It can range from A to "x", where x is the letter corresponding to the maximum number of outlet lines in the default file (screen 11 in the Change Default Data program). For example, "x" would be E if the maximum number was 5.

OUTLET STA. MUST BE > OUTLET STA. ON UPHILL TER/DIV : If an outlet station entered on a previous (lower numbered practice) is not less than the station entered on the current station, you will get this message.

OUTLET STA. MUST BE < OUTLET STA. ON DOWNHILL TER/DIV : If an outlet station entered on a subsequent (higher numbered practice) is less than the station entered on the current station, you will get this message.

PRACTICE STA. MUST BE => FROM STA. AND <= TO STA. : The station along the practice where the outlet occurs must be between the FROM and TO STATIONS.

TO STATION MUST BE > FROM STATION : See same message under Screen 2 above.

TO STATION MUST BE < TO STATION OF NEXT REACH : The TO STATION of current reach must be less than the TO STATION of the next reach.

TO STATION MUST BE <= TO MAX PROFILE STATION : See same message under Screen 2 above.

Terrace/Diversion Design	**SCREEN 4**

CANNOT JOIN AN OUTLET WHICH WOULD FORM A CLOSED LOOP : The current outlet cannot join an outlet that is defined to join the current outlet. For example, you cannot enter a JCT ID of "A" for outlet B when outlet A has a JCT ID of "B".

END ELEV. MUST BE < # : "#" indicates a number that is the maximum elevation that can be entered. This value is determined from the elevation of last outlet station given on screen 3.

END STA OF JOINED OUTLET HAS NOT BEEN DEFINED : You must enter an END STATION for the outlet you are joining before the junction station can be input.

END STA. MUST BE > # : "#" will be the minimum END STATION that can be entered, which will correspond to the largest outlet station from screen 3.

JCT ID MUST BE INPUT FIRST : You cannot enter the junction station until you have input the JUNCTION ID.

JCT STA. MUST BE < # : The junction station should be less than the number displayed. This value is obtained from the the END STATION of JCT ID.

JCT STA. MUST BE >= # : The junction station should be greater than or equal to the number displayed. This number is the beginning station of the joined outlet on screen 3.

NO OUTLET DATA HAS BEEN ENTERED ON SCREEN 3 : This message indicates that data for one or more outlets was not entered on screen 3. You should return to screen 3 and enter appropriate data.

NO OUTLET ELEVATIONS HAVE BEEN ENTERED ON SCREEN 3 : Outlet IDs have been entered on screen 3, but no elevation information. This message occurs when trying to enter end elevation.

NO OUTLET STATIONS HAVE BEEN ENTERED ON SCREEN 3 : Outlet IDs have been entered on screen

3, but no station information. This message appears when trying to enter end station.

OUTLET CANNOT BE JOINED TO A DIFFERENT TYPE OUTLET : You cannot join two different types of outlets (e.g., an underground outlet to a grassed waterway).

OUTLET CANNOT BE JOINED TO ITSELF : Joining an outlet to itself is not allowed, since it would eliminate an end to the outlet.

OUTLET TYPE MUST BE ONE OF THE CODES SHOWN ABOVE : The type must be a number from 1 to 4 as follows: 1 - underground outlet, 2 - grassed waterway, 3 - infiltration basin, or 4 - structure.

OUTLET USED FOR JCT. HAS NOT BEEN DEFINED ON SCREEN 3 : You entered a letter for an outlet that does not exist. Either enter a different letter or define the outlet on screen 3.

STRUCTURE OUTLET - NO OUTLET GRADELINE REQUIRED : This is not actually an error message. It is simply an informative message saying that no data is required from this screen.

Terrace/Diversion Design	**SCREEN 5**

INLET DEPTH MUST BE >= MINIMUM INLET DEPTH OF # : An inlet depth (see 4 on page 8 for a definition) was entered that was less than the minimum depth ("#") stored in the default file (screen 7 of the Change Default Data program).

INLET NOT AVAILABLE IN THIS SIZE : The inlet size you entered was not defined for the inlet type chosen. You will need to select another size or add this size to the list of inlets on screen 8 of the Change Default Data program.

INLET TYPE MUST BE ONE OF THE CODES SHOWN ABOVE : This must be a number from 1 to 4 as shown on the screen just above this error message. These types are defined on screen 8 of the Change Default Data program.

INLET TYPE NOT DEFINED : You have entered a number from 1 to 4, but the number you entered has no inlet type defined for it (i.e., it is blank). These types are defined on screen 8 of the Change Default Data program.

NO INLETS HAVE BEEN DEFINED ON SCREEN 3 AND SCREEN 4 : No intersections of practice and outlet have been defined on screens 3 or 4. Usually this will only occur when both screens are blank.

ORIFICE DEPTH MUST BE <= INLET DEPTH : The orifice depth cannot physically be greater than the inlet depth. See 4 for a sketch of these depths.

Terrace/Diversion Design	**SCREEN 6**

CURRENT REACH AT END OF OUTLET : You pressed <*F5*> to go to the next reach when the reach you are on currently is the end of the outlet.

CURRENT REACH AT START OF OUTLET : You pressed <*F6*> to go to the previous reach when the reach you are on currently is the start of the outlet.

CURRENT REACH DATA INCOMPLETE : You need to finish entering the appropriate data for this reach before continuing to another reach.

DATA MAY ONLY BE INPUT FOR END REACH : Values can only be entered or changed for the last reach. If you wish to change a previous reach, you will need to delete all the reachs beyond the desired reach so that it will become the last reach.

ELEVATION MUST BE > # : You must enter a "#" greater than the outlet elevation of the next (downhill) inlet.

ELEVATION MUST BE < # : You must enter a "#" less than the "FROM ELEV".

END STA ON SCREEN 4 MUST BE ENTERED PRIOR TO GRADELINE INPUT : The end station for an outlet has been left blank on screen 4. You can not define the gradeline until that value is entered.

INFILTRATION OUTLET - NO OUTLET GRADELINE REQUIRED : This is not an error message. It just lets you know that the information on this screen is not required for this outlet.

NO INLET DATA HAS BEEN ENTERED ON SCREEN 5 : You need to return to screen 5 and make sure the inlet data is entered, specifically the inlet depth.

NO MORE REACHES ALLOWED : You are limited to 12 reaches.

NO OUTLET GROUND DATA AT THIS STA - CUT/FILL CANNOT BE USED : If you are not using outlet ground data or there is no data for this particular outlet, you cannot enter a cut or fill value.

OUTLET ELEV ON SCREEN 4 MUST BE ENTERED PRIOR TO GRADELINE INPUT : The end elevation of the outlet is blank on screen 4. This must be entered in order to define the gradeline.

OUTLET STA ON SCREEN 3 MUST BE ENTERED PRIOR TO GRADELINE INPUT : The outlet station is blank on screen 3. This must be entered in order to define the gradeline.

OUTLET TYPE NOT DEFINED ON SCREEN 4 : The type of outlet is not known. This is selected on screen 4.

STA MUST BE > # : The station you enter should be greater than the "FROM STA".

STA MUST BE <= # : The station you enter should be not be greater than the station of the next inlet.

STRUCTURE OUTLET - NO OUTLET GRADELINE REQUIRED : This is not an error message. It just lets you know that the information on this screen is not required for this outlet.

TO STA MUST BE ENTERED PRIOR TO ELEV, C/F, OR % GRADE ENTRY : You cannot enter elevation, cut/fill, or a percent grade until you have input the TO STATION.

Terrace/Diversion Design	**SCREEN 7**

CAPACITY FOR THIS SIZE < MINIMUM REQUIRED : The capacity of the chosen conduit is too small. Select a larger conduit.

CONDUIT SIZE REQUIRED > SIZE AVAILABLE : This error occurs when the calculated conduit size is greater than 24 inches.

CONDUIT TYPE MUST BE ONE OF THE CODES SHOWN ABOVE : The conduit type should be a number from 1 to 6. The types available are shown on the screen just above this error message. These types can be modified using the Change Default Data program (screen 2).

CONDUIT TYPE NOT DEFINED : You entered a value from 1 to 6 which does not have any conduit information (see screens 2 and 3 in the Change Default Data program).

CONDUIT TYPE NOT IDENTIFIED : In order to enter release time or conduit size, a conduit type must be entered.

CONDUIT VELOCITY > ALLOWABLE CONDUIT VELOCITY : The calculated velocity is greater than the maximum allowable, which is set in screen 2 of the Change Default Data program.

DRAINAGE AREA = 0 : The watershed drainage area, which was determined on screen 2 of the Design program, is 0. You will need to return to that screen and provide the necessary information.

FIXED VOLUME OF RUNOFF NOT DEFINED : The fixed volume value on screen 10 of the Change Default Data program was not entered (i.e., blank).

FLOOD ROUTING FORMULA PARAMETERS NOT DEFINED : The formula values on screen 10 of the Change Default Data program were not entered (i.e., blank).

HYDRAULIC GRADELINE ELEV > JCT ELEV : This can occur if the hydraulic gradeline is being controlled by a pool downstream and the pool elevation is greater than a junction elevation.

HYDRAULIC GRADELINE ELEV. > ORIFICE ELEV. : This can occur if the hydraulic gradeline is being controlled by a pool downstream and the pool elevation is greater than a orifice elevation.

HYDRAULIC HEAD <= 0 : This can occur in a conduit inflow control situation where a downstream pool elevation is greater than an upstream pool elevation.

INFILTRATION OUTLET - NO OUTLET DESIGN REQUIRED : This is not an error message. It is just telling you that the information on this screen is not required for this outlet.

MAXIMUM ALLOWED CONDUIT SIZE = 24 INCHES : You have to enter a conduit size less than or equal to 24 inches.

NO OUTLET GRADELINE HAS BEEN ENTERED ON SCREEN 6 : The outlet gradeline was not defined on screen 6.

RELEASE TIME MAY ONLY BE ENTERED FOR REACHES WITH INLETS : You cannot enter the release time for a reach without an inlet. This is indicated by an "inflow point" of "NONE".

RELEASE TIME MUST BE > 0 AND < # : Release time must be a positive number less than the maximum "#" defined in the Change Default Data program (screen 11).

RELEASE TIME WOULD GIVE RELEASE RATE < MINIMUM RELEASE RATE : Entering a release time that results in a release rate less than the minimum defined on screen 7 of the Change Default Data program gives this error.

RUNOFF VOLUME = 0 : The calculated runoff volume is 0. This could happen if a low enough curve number is entered on screen 2. The runoff volume is displayed on screen 3.

SIZE MAY ONLY BE INPUT FOR REACHES WITH INLETS : You cannot enter the conduit size for a reach without an inlet. This is indicated by an "inflow point" of "NONE".

SIZE NOT AVAILABLE FOR GIVEN CONDUIT TYPE : The size you entered is not available. For the sizes you can use, see screen 3 of the Change Default Data program.

STORAGE VOLUME CALCULATION METHOD NOT DEFINED : You need to select which method you wish to use to calculate storage volume. This is done on screen 10 of the Change Default Data program.

STRUCTURE OUTLET - NO OUTLET DESIGN REQUIRED : This is not really an error message. It is just telling you that the information on this screen is not required for this type of outlet.

Terrace/Diversion Design **SCREEN 8**

BACK SLOPE RATIO < MINIMUM REQUIRED : The back slope ratio entered is less than the minimum value specified on screen 4 of the Change Default Data program.

BOTTOM WIDTH MUST BE >= # : The bottom width must be greater than or equal to the value specified on screen 6 of the Change Default Data program.

CODE MUST BE ONE OF THE VALUES SHOWN ABOVE : The XSEC SHAPE must be a code from 1 to 4. These codes correspond to shapes defined on screen 4 of the Change Default Data program.

FRONT CUT SLOPE RATIO < MINIMUM REQUIRED : The front cut slope ratio entered is less than the minimum value specified on screen 4 of the Change Default Data program.

FRONT SLOPE RATIO < MINIMUM REQUIRED : The front slope ratio entered is less than the minimum value specified on screen 4 of the Change Default Data program.

OUTLET REACH LOCATION DATA NOT COMPLETE ON SCREEN 3 : The outlet data on screen was not completed for this practice.

TO STATION MUST BE > FROM STATION : The reaches must be entered in an increasing manner, where "to station" must always be greater than "from station".

TO STATION MUST BE <= TO MAX PROFILE STATION : The "to station" cannot be beyond the last profile station in the data file.

TOP WIDTH MUST BE >= # : The top width must be greater than or equal to the value specified on screen 6 of the Change Default Data program.

X-SECTION SHAPE NOT DEFINED : A code of 1 to 4 was entered, but that code does not have any information for it. (See screen 4 of the Change Default Data program.)

Terrace/Diversion Design **SCREEN 9**

% GRADE MUST BE > 0 : You cannot enter a negative percent grade.

CURRENT REACH AT END OF PRACTICE : You pressed <*F5*> to go to the next reach when the reach you are on currently is the end of the practice.

CURRENT REACH AT START OF PRACTICE : You pressed <*F6*> to go to the previous reach when the reach you are on currently is the start of the practice.

CURRENT REACH DATA INCOMPLETE : You need to finish entering the appropriate data for this reach before continuing to another reach.

DATA MAY ONLY BE INPUT FOR END REACH : The end reach is the only reach that you can input or modify. If you wish to change a previous reach, you will need to the delete the desired reach and reenter all following reaches.

ELEVATION MUST BE > # : If you are moving toward the outlet, the elevation should be greater than the outlet elevation. If you are moving away from the outlet, the elevation should be greater than the "FROM ELEV".

GRADELINE CONNECTED WITH OUTLET ELEV - NO INPUT ALLOWED : You cannot enter an elevation which would change the outlet elevation. The outlet elevation is defined on screen 3 and cannot be changed here.

NO MORE REACHES ALLOWED : You are limited to 12 reaches.

OUTLET REACH LOCATION DATA NOT COMPLETE ON SCREEN 3 : The outlet data on screen was not completed for this practice.

STA MUST BE > # : You cannot enter a station less than the "from station".

STA MUST BE <= # : A gradeline reach must occur at each inlet or watershed break.

TO STA MUST BE ENTERED PRIOR TO ELEV, C/F, OR % GRADE ENTRY : You cannot enter elevation, cut/fill, or a percent grade until you have input the TO STATION.

VALUE RESULTS IN NEGATIVE GRADE OR ELEV < OUTLET ELEV : An elevation or a cut/fill value was entered which resulted in a negative channel grade or an elevation lower than the outlet elevation.

Terrace/Diversion Design	**SCREEN 10**

CHANNEL SIDE SLOPES NOT DEFINED : The channel side slopes were not completely defined on screen 8.

EROSION RESISTANCE CODE NOT DEFINED : A code of 1 for resistant, 2 for drainage, or 3 for easily eroded must be entered.

FLOW RATE NOT DEFINED : The watershed peak flow rate was not calculated.

LINING TYPE CODE NOT DEFINED : A code of 1 for earth or 2 for grass needs to be entered.

LINING TYPE NOT DEFINED : The lining type flow factors are not complete in the default file (screen 9).

NO PRACTICE GRADELINE HAS BEEN ENTERED ON SCREEN 9 : This message appears when the gradeline has not been defined on screen 9. This normally happens when you try to go to the next practice which has no data.

REACH VELOCITY > MAXIMUM ALLOWABLE VELOCITY : If the calculated velocity for the reach exceeds the maximum velocity entered on screen 9 of the Change Default Data program, this error occurs.

WATERSHED INFORMATION NOT COMPLETE ON SCREEN 2 : The watershed data on screen 2 has not been completed for the area covered by the practice.

X-SECTION SHAPE NOT DEFINED : The x-section shape was not completely defined on screen 8 of the Change Default Data program.

Terrace/Diversion Design **SCREEN 11**

CHANNEL FLOW DATA NOT AVAILABLE FOR THIS PRACTICE : The data for screen 10 is blank which most likely occurs if you skip screen 10 and go directly to screen 11.

CHANNEL FLOW DEPTH NOT DEFINED : This occurs if the channel flow calculations on screen 10 were not done or failed.

CUT/FILL BALANCE ADJUSTMENT METHOD NOT DEFINED : A value of 1 to 4 must be entered. These codes are described on the screen just above this message.

DATA REQUIRED FOR DESIGN NOT COMPLETE : Some data needed for the design is missing. You will need to review the data on previous screens to determine which data is missing.

DESIGN X-SECTION TYPE NOT DEFINED : The XSEC SHAPE code was not entered on screen 8.

INLET SIZE WITH CAPACITY (@ DESIGN HYD. HEAD) > RELEASE RATE NOT FOUND : During the calculations, an inlet size could not be found with a large enough capacity. The inlets searched are the ones defined on screen 8 of the Change Default Data program.

NO PRACTICE GRADELINE HAS BEEN ENTERED ON SCREEN 9 : This message is informing you that the gradeline was not completely defined on screen 9.

OUTLET REACH LOCATION DATA NOT COMPLETE ON SCREEN 3 : You need to return to screen 3 and complete the reach location data.

OUTLET TYPE NOT DEFINED ON SCREEN 4 : The outlet type was left blank on screen 4.

RELEASE RATE HAS NOT BEEN DETERMINED ON SCREEN 7 : The release rate was not calculated on screen 7. This could result from skipping screen 7 or not entering a conduit type, release time, or conduit size.

RELEASE RATE NOT DEFINED : Release rate was not completed on screen 7.

RELEASE TIME NOT DEFINED : Release time was not completed on screen 7.

REQUIRED STORAGE VOLUME NOT DEFINED : The required storage volume was not completed on screen 7.

Terrace/Diversion Design	**SCREEN 12**

COMPLETED DESIGN NOT AVAILABLE FOR THIS PRACTICE : Some data needed for the design is missing. You will need to review the data on previous screens to determine which data is missing. It could also be that all the calculations on screen 11 were not completed.

CURRENT OUTLET AT END OF PRACTICE : You pressed <*F5*> to go to the next outlet when the current outlet is the last outlet for the practice.

CURRENT OUTLET AT START OF PRACTICE : You pressed <*F6*> to go to the previous outlet when the current outlet is the first outlet of the practice.

CURRENT X-SECTION AT END OF PRACTICE : You pressed <*F5*> to go to the next cross-section when the current cross-section is the last one for the practice.

CURRENT X-SECTION AT START OF PRACTICE : You pressed <*F6*> to go to the previous cross-section when the current cross-section is the first one of the practice.

DESIGN PROFILES NOT AVAILABLE FOR THIS PRACTICE : You will receive this message when you try to move beyond the last practice which has data.

DISPLAY TYPE MUST BE ONE OF THE CODES SHOWN ABOVE : A number from 1 to 3 must be entered to choose what to display as follows: 1 - profile, 2 - cross-section, or 3 - cut/fill balance profile.

SPOIL/BORROW DATA NOT AVAILABLE FOR THIS PRACTICE : There is no spoil/borrow data to plot.

X-SECTION DATA NOT AVAILABLE FOR THIS PRACTICE : There is no x-section data to plot.

PRINT/PLOT DATA ERROR MESSAGES

If the graphical screens (plots) are not being printed (only text is being printed), the program GRAPHICS was not executed prior to running the print/plot program. The batch file (TD) which starts the program assumes the GRAPHICS program is either in a directory (normally your DOS directory) which is in your current PATH (see PATH in DOS manual) or is in the same directory as the Terrace/Diversion Design program.

DEVICE TIMEOUT : This usually occurs because the printer is turned off, off-line, or not connected.

PRINTER FAULT : This normally indicates that the printer is turned off, off-line, or not connected correctly. If it is turned on, online, and connected properly, a hardware problem exists.

PRINTER OUT OF PAPER : If you try to print and your printer is out of paper, you will receive this message.

APPENDIX C - TECHNICAL INFORMATION

EQUATIONS

HYDROLOGY

FLOODROUTING

Floodrouting is performed using a procedure documented by Larry Caldwell in ASAE paper 85-2544 "Determination of Storage Requirements for Underground Outlet Terraces in the Midwest". The "proposed method" curve shown in Figure 12 from that paper was matched with a curve fitting equation and the units of storage were converted from a per unit area to a total drainage area basis yielding equation 1.

$$V_s = A\left(\frac{V_r^{\,B}}{Q^C}\right) \qquad \text{(Eqn. 1)}$$

where:

V_s = volume of storage (acre-ft),
V_r = volume of runoff (acre-inches),
Q = release rate (ft^3/sec), and
A,B,C = curve fitting coefficients.

Changing the curve fitting coefficients would allow the formula to match other procedures shown in Figure 12 (of the ASAE paper) such as the TR-55 procedure or the Illinois procedure.

RUNOFF

Runoff is calculated using the SCS Runoff Curve Number procedures found in SCS-TR-55 "Urban Hydrology for Small Watersheds", Appendix F - Figure 2-1 (runoff equation) shown below.

$$Q = \frac{\left[P - 0.2\left(\frac{1000}{CN} - 10\right)\right]^2}{P + 0.8\left(\frac{1000}{CN} - 10\right)} \quad \text{[TR-55, Appendix F - Figure 2-1]} \qquad \text{(Eqn. 2)}$$

where:

Q = runoff (inches),
P = rainfall (inches), and
CN = Runoff Curve Number.

TIME OF CONCENTRATION

Time of concentration is calculated using procedures found in SCS-TR-55 "Urban Hydrology for Small Watersheds", equations 3-1, 3-2, 3-3, and Appendix F - Figure 3-1.

The equation used for channel flow is

$$T_t = \frac{L}{3600\,V} \quad [TR\text{-}55, Eq.\,3\text{-}1] \qquad \text{(Eqn. 3)}$$

where:

T_t = travel time (hours),
L = flow length (ft),
V = average velocity (ft/sec), and
3600 = conversion factor from seconds to hours.

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \quad [TR\text{-}55, Eq.\,3\text{-}2] \qquad \text{(Eqn. 4)}$$

where:

T_c = time of concentration (hours),
m = number of flow segments.

For sheet flow of less than 300 feet, the equation used is

$$T_t = \frac{0.007\ (nL)^{0.8}}{(P_2)^{0.5}\ s^{0.4}} \quad [TR\text{-}55, Eq.\,3\text{-}3] \qquad \text{(Eqn. 5)}$$

where:

n = Manning's roughness coefficient for sheet flow,
P_2 = 2 year - 24 hour rainfall (inches), and
s = land slope (ft/ft).

The equation (unpaved condition) for Figure 3-1 given in Appendix F of TR-55 is shown below. This is for shallow concentrated flow (>300 feet).

$$V_{ave} = 16.1345\,s^{0.5} \qquad \text{(Eqn. 6)}$$

where:

V_{ave} = average shallow concentrated flow velocity (ft/sec), and
s = watercourse slope (ft/ft).

2 YEAR, 24 HOUR RAINFALL

The 2 year - 24 hour rainfall required in equation 5 above was approximated from other frequency design storms using the following equation.

$$P_2 = \left(\frac{2}{F_{des}} \right)^{0.25} P_{des} \quad \text{(Eqn. 7)}$$

where:

P_2 = 2 year - 24 hour rainfall (inches),
P_{des} = design storm - 24 hour rainfall (inches), and
F_{des} = design storm frequency (years).

PEAK RATE OF RUNOFF

Peak rate of runoff is calculated using procedures found in SCS-TR-55 "Urban Hydrology for Small Watersheds", equations 2-2 and 2-4, Appendix F - Exhibit 4, and Appendix F - Table F-1.

$$I_a = 0.2S \quad [TR\text{-}55, Eq.2\text{-}2] \quad \text{(Eqn. 8)}$$

where:

I_a = initial abstraction, and
S = potential maximum retention after runoff begins (inches).

$$S = \frac{1000}{CN} - 10 \quad [TR\text{-}55, Eq.2\text{-}4] \quad \text{(Eqn. 9)}$$

where:

CN = Runoff Curve Number.

Equations 8 and 9 are combined yielding

$$I_a = \frac{200}{CN} - 2 \quad \text{(Eqn. 10)}$$

The unit peak discharge is calculated with the following equation.

$$\log(q_u) = C_0 + C_1 \log(T_c) + C_2 [\log(T_c)]^2 \quad [TR\text{-}55, Appendix\ F\text{-}Exhibit\ 4] \quad \text{(Eqn. 11)}$$

where:

q_u = unit peak discharge (cfs/sq.mile/inch of runoff),
T_c = time of concentration (hours)
(minimum, 0.1; maximum, 10.0), and
C_0, C_1, C_2 = coefficients from the table below [TR-55, Table F-1].

TR-55, Appendix F - Table F-1

I_a/P	C_0	C_1	C_2
0.10	2.55323	-0.61512	-0.16403
0.30	2.46532	-0.62257	-0.11657
0.35	2.41896	-0.61594	-0.08820
0.40	2.36409	-0.59851	-0.05621
0.45	2.29238	-0.57005	-0.02281
0.50	2.20282	-0.51599	-0.01259

* I_a/P = Initial abstraction / Rainfall (inches)

OPEN CHANNEL HYDRAULICS

The following basic hydraulic equations found in Chapter 3 of the Engineering Field Manual (EFM) are used in calculating open channel flow conditions.

From Exhibit 3-15,

Trapezoidal Channel Geometry

$$A = B\,D + Z\,D^2 \qquad \text{(Eqn. 12)}$$

where:

A = area (ft^2),
B = bottom width (ft),
Z = side slope ratio, and
D = flow depth (ft).

Trapezoidal Channel Hydraulic Radius

$$R = \frac{B\,D + Z\,D^2}{B + 2\,D\,\sqrt{Z^2 + 1}} \qquad \text{(Eqn. 13)}$$

where:

R = hydraulic radius (ft).

The continuity equation is shown below.

$$Q = A\ V \quad [\text{EFM, Eqn. } 3\text{-}4] \qquad \text{(Eqn. 14)}$$

where:

Q = discharge (ft/sec),
A = cross-sectional area (ft^2), and
V = mean velocity (ft/sec).

Manning's equation is as follows.

$$V = \frac{1.486}{n} R^{2/3}\ S^{1/2} \quad [\text{EFM, Eqn. } 3\text{-}6] \qquad \text{(Eqn. 15)}$$

where:

V = mean velocity (ft/sec),
n = Manning's roughness coefficient,
R = hydraulic radius (ft), and
S = slope of energy gradeline (ft/ft).

The following equations, found in Agricultural Handbook No. 667 (AH-667), "Stability Design of Grass-Lined Open Channels", are used in the calculation of flow in grass lined channels.

$$n_R = e^{\{C_I\ (0.0133[\ln(VR)]^2 - 0.0954\ \ln(VR) + 0.297) - 4.16\}} \quad [\text{AH-667, Eqn. } 1.2] \qquad \text{(Eqn. 16)}$$

$$\text{with the limits of}$$

$$0.0025\, C_I^{\,2.5} \le VR \le 36$$

where:

n_R = a reference value of Manning's resistance coefficient, and
C_I = retardance curve index describing the retardance potential of the vegetal cover.

Retardance curve index by SCS (1954) retardance class
(AH-667, Table 3.2)

SCS Retardance Class	Retardance Curve Index (C_I)
A	10.0
B	7.64
C	5.60
D	4.44
E	2.88

PIPE HYDRAULICS

The following basic hydraulic equations found in Chapter 3 of the Engineering Field Manual (EFM) are used in calculating pipe flow conditions. The pipe discharge is computed as follows

$$Q = a\sqrt{\frac{2gH}{1 + K_m + K_p L}} \quad [\text{EFM, Eqn. 3-12}] \qquad \text{(Eqn. 17)}$$

where:

Q = discharge (ft^3/sec),
a = pipe area (ft^2),
g = acceleration of gravity (32.2 ft/sec^2),
H = elevation head differential (ft),
K_m = coefficient of minor losses,
K_p = pipe head loss coefficient, and
L = pipe length (ft).

The pipe head loss coefficient, K_p in the above equation, is calculated as follows.

$$K_p = \frac{5087\, n^2}{d_i^{4/3}} \quad [\text{EFM, Eqn. 3-9}] \qquad \text{(Eqn. 18)}$$

where:

n = Manning's roughness coefficient, and
d_i = diameter of pipe (inches).

INLET HYDRAULICS

The following basic hydraulic equations found in Chapter 3 of the Engineering Field Manual (EFM) are used in calculating inlet flow conditions.

The discharge for weir flow is described by the following equation.

$$Q = CLH^{3/2} \quad [\text{EFM, Eqn. 3-21}] \qquad \text{(Eqn. 19)}$$

where:

Q = discharge (ft^3/sec),
H = measured head (ft),
L = length of weir (ft), and
C = weir coefficient (3.2 was used for inlet weirs).

The discharge for orifice flow is computed with the equation

$$Q = C\ a\sqrt{2gh} \quad [\text{EFM, Eqn. 3-25}] \qquad \text{(Eqn. 20)}$$

where:

Q = discharge (ft^3/sec),
C = discharge coefficient,
a = orifice cross-sectional area (ft^2),
g = acceleration of gravity (32.2 ft/sec^2), and
h = orifice head (feet).

SEDIMENT VOLUME

The volume of sediment planned for the storage pool is calculated using the following equation.

$$V_{sed} = \frac{T \; L \; S_{loss} \; A}{\gamma_{sed} \; 2178} \qquad \text{(Eqn. 21)}$$

where:

V_{sed} = volume of sediment (acre-ft),
T = trap efficiency (%),
L = design life (years),
S_{loss} = watershed soil loss rate (tons/acre/year),
A = watershed area (acres), and
γ_{sed} = sediment density (lbs/ft^3).

WATERSHED AREA

The watershed area is calculated with the following equation.

$$A = \frac{W\,(STA_2 - STA_1)}{43{,}560} \qquad \text{(Eqn. 22)}$$

where:

A = watershed area (acres),
W = average reach width (ft),
STA_1 = "From Station" (ft), and
STA_2 = "To Station" (ft).

RELEASE RATE / RELEASE TIME

The following equations are based on drainage coefficient equations and assume a constant rate of discharge of water from the storage area.

$$Q_{rel} = \frac{12.1\,V_{runoff}}{T_{rel}} \qquad \text{(Eqn. 23)}$$

where:

Q_{rel} = discharge (ft^3/sec) from storage area,
V_{runoff} = volume of runoff (acre-ft), and
T_{rel} = release time (hours).

The following equation is used to determine minimum release time from minimum release rate. INT refers to making the result an integer.

$$T_{min} = INT\left(\frac{12.1\,V_{runoff}}{A_{ws}\,Q_{min}}\right) \quad \text{(Eqn. 24)}$$

where:

T_{min} = minimum release time (hours),
V_{runoff} = volume of runoff (acre-ft),
A_{ws} = area of watershed (acres), and
Q_{min} = minimum release rate (cfs/acre).

SPOIL/BORROW VOLUMES

$$V_{AF} = V_C\,D_r \quad \text{(Eqn. 25)}$$

where:

V_{AF} = volume of available fill (cubic yds.),
V_C = volume of cut (cubic yds.), and
D_r = cut/fill density ratio.

$$V_B = (\,V_F - V_{AF}\,) / D_r \quad \text{(Eqn. 26)}$$

where:

V_B = volume of borrow (cubic yds.), and
V_F = volume of fill.

$$V_S = V_{AF} - V_F \quad \text{(Eqn. 27)}$$

where:

V_S = volume of spoil (cubic yds.)

DESIGN MODULE CALCULATION PROCEDURES

The procedures used to calculate various values are described in this section. The procedures are arranged by screens and column or row headings.

SCREEN 2

WATERSHED AREA

Watershed area is calculated if average width is entered. Equation 22 above is used. The answer is rounded to the nearest 0.01 acres.

RUNOFF DEPTH

Runoff depth is calculated if a Runoff Curve Number is entered. Equation 2 is used. The design storm rainfall depth in the default file is used as the rainfall depth. The answer is rounded to the nearest 0.01 inch.

SCREEN 3

WATERSHED AREA

The watershed area (acres) is calculated by overlaying the screen 3 outlet reaches over the screen 2 watershed reaches. The watershed reach areas are apportioned to the appropriate outlet reaches.

RUNOFF VOLUME

The runoff volume is calculated by overlaying the screen 3 outlet reaches over the screen 2 watershed reaches. The watershed reach runoff volume is calculated by multiplying the watershed reach area times the runoff depth and converting it to acre-feet. The watershed reach runoff volumes are then apportioned to the appropriate outlet reaches. The volume is rounded to the nearest 0.01 acre-ft.

SCREEN 4

WATERSHED AREA

The watershed area is calculated by adding all of the screen 3 outlet reach watershed areas with the same outlet ID.

SCREEN 5

INLET SIZE

Inlet size is calculated after pool depth is calculated on screen 12 for the pool in which the inlet is located. The inlet size is calculated using the following steps.

A. The default inlet characteristic file is searched for the smallest inlet size of the inlet type specified on screen 5.

B. The inlet head is determining by multiplying the default % hydraulic head times the pool depth.

C. If the inlet head is greater than inlet height and the inlet top opening is greater than 0, the top opening capacity as an orifice is calculated using equation 20. The head used is the inlet head minus inlet height. The default orifice C value is used for the C value. The orifice area is the top opening area. The capacity is reduced by the default % of top opening assumed plugged ratio.

D. If the inlet head is greater than inlet height and the top opening area is greater than 0, the top opening capacity as a weir is calculated using equation 19. The head used is the inlet head minus inlet height. The weir length used is calculated from the inlet top opening area assuming that the opening is circular. The capacity is reduced by the default % of top opening assumed plugged ratio.

E. The capacity of the holes in the side of the inlet is calculated using equation 20. The head used is the inlet head / 2. The default orifice C value is used for the C value. The area used is determined by multiplying the inlet height covered by the inlet head times the inlet open area for the inlet type and size.

F. The maximum possible capacity of the inlet is calculated using equation 20. The head used is the inlet head. The default orifice C value is used for the C value. The area used is the inlet flow area.

G. The top opening capacity is selected as the smaller of the orifice capacity in step C or the weir capacity in step D. The top opening capacity is added to the side hole capacity in step E to calculate the total inlet capacity. If the total inlet capacity is greater than the maximum possible capacity in step F, the total capacity is set equal to the maximum possible capacity.

H. If the inlet capacity is less than the release rate given on screen 11 then the size is incremented to the next size available in the inlet type being used. If no larger inlet sizes are available, step B to H is repeated until a size with capacity greater than or equal to the release rate is found. If a size meeting the capacity requirements is not found, the size is set as "SNF" (Size Not Found).

I. If the inlet size on screen 5 is blank or is less than the size calculated, the inlet size is set equal to the size found meeting the capacity requirements.

ORIFICE DIAMETER

The orifice diameter is calculated after the pool depth on screen 11 has been calculated, if an orifice depth has been entered on screen 5. Equation 20 is solved for the orifice cross-sectional area. The head used is the orifice depth plus the pool depth times % hydraulic head from the default file. The orifice diameter is calculated from the orifice area assuming a circular orifice. The orifice diameter is rounded to the nearest 0.25 inches.

SCREENS 6 AND 9

If the FROM or TO STATION CUT/FILL is entered, elevation is calculated by adding the cut/fill to the ground elevation at the outlet or channel centerline. If the centerline does not fall on actual ground data points in a x-section, the ground elevation at the centerline is extrapolated from the x-section data assuming that the ground is a straight line between points or a straight line through the first or last two points of the x-section. If the station does not fall on a x-section, the ground elevation is extrapolated as a straight line between the centerline of the proceeding and following stations.

If the FROM or TO ELEV is entered, the cut/fill is calculated by subtracting the gradeline elevation from the ground elevation at the outlet or channel centerline.

If % GRADE is entered, the gradeline elevation and cut/fill are calculated using the above procedures.

SCREEN 7

ACCUMULATED DRAINAGE AREA

The accumulated drainage area is determined by adding:

A. All outlet watershed areas on screen 3 with the same outlet ID as screen 7 with an outlet station less than or equal to the reach "to station".

B. All outlet watershed areas on screen 4 with the same junction ID as the screen 7 outlet ID and with an outlet station less than or equal to the reach "to station".

RELEASE TIME / CONDUIT SIZE

Entering **RELEASE TIME** on screen 7 causes the following calculations to occur.

A. The release time entered is checked against the minimum release time in the default file. If the release time is greater than the minimum release time, the input is not accepted.

B. The release time entered is checked against the minimum release rate in the default file by calculating a minimum release time using equation 24. If the minimum release time is less than the entered release time, the release time is set equal to the minimum design release time.

C. The release rate for the reach is calculated using equation 23.

D. The required pool floodwater storage volume is calculated using the volume calculation procedure selected in the Change Default Data program (screen 10).

   If procedure 1 was selected, equation 1 is used with the appropriate runoff volume from screen 3.

   If procedure 2 was chosen, the storage volume is determined by multiplying the appropriate watershed area and runoff volume on screen 3.

   If procedure 3 was selected, storage volume is determined by multiplying the appropriate watershed on screen 3 with the fixed runoff depth.

E. The required conduit capacity is determined by adding the release rate to the upstream reach required conduit capacity.

F. The conduit size is determined using the following procedures based on inflow control type.

   1. CONDUIT CONTROL.

      Conduit control will be displayed if no orifice depth was entered for the inlet on screen 5.

a. Conduit size is set to the smallest size available in the default file for the conduit type entered on screen 7.

b. The next control point is determined. The control point may be the next inlet, junction, or the outlet.

c. The conduit capacity to the next control point is calculated using equation 17. K_m is set equal to the default file K_e (entrance loss coefficient). K_p is determined using equation 18 and the default file Manning's n value. L is set equal to the distance to the next control point.

   If the next control point is an inlet, H is set equal to the difference between the two inlet elevations.

   If the next control point is a junction, H is set equal to the inlet elevation plus the default file assumed pool depth minus the conduit gradeline at the junction.

   If the next control point is the outlet, H is set equal to the inlet elevation plus the default file assumed pool depth minus the outlet elevation or tailwater elevation.

d. If the calculated conduit capacity is less than the required conduit capacity, the conduit size is incremented to the next available size and step c is repeated.

e. If the calculated conduit capacity is greater than or equal to the required conduit capacity, the conduit size is accepted and the required capacity is set equal to the actual capacity.

f. A new release rate is determined by subtracting the upstream reach required capacity from the reach required capacity.

g. A new release time is calculated using equation 23.

h. If storage volume calculation method 1 is being used, a new storage volume is calculated using equation 1. The release rate used in equation 1 is checked against the default file maximum discharge times the watershed area and the smaller of the two values is used.

i. The conduit size, required capacity and conduit capacity for all reaches up to the next control point are set equal to the values for the current reach.

2. ORIFICE CONTROL

Orifice control will be displayed if an orifice depth was entered for the inlet on screen 5.

a. Conduit size is set to the smallest size available in the default file for the conduit type entered on screen 7.

b. The next control point is determined. The control point may be the next inlet, junction, or the outlet.

c. The conduit capacity of the reach is calculated using equation 17. K_m is set equal to 0. K_p is determined using equation 18 and the default file Manning's n value. L is set equal to the reach length.

If the next reach is not a control point, H is set equal to the conduit grade times L.

If the next reach is an inlet control point with orifice inflow control, H is set equal to the conduit grade times L.

If the next reach is an inlet control point with conduit inflow control, H is set equal to the start of the reach conduit gradeline elevation minus the inlet elevation plus the default file assumed pool depth.

If the next reach is a junction control point, H is set equal to the conduit grade times L.

If the end of the reach is the outlet, H is set equal to the start of the reach conduit gradeline elevation minus the outlet elevation or tailwater elevation.

d. If the calculated conduit capacity is less than the required conduit capacity, the conduit size is incremented to the next available size and step c is repeated.

e. If the conduit capacity is greater than or equal to the required conduit capacity, the conduit size is accepted.

f. If the next reach is not the next control point, the reach number is incremented and steps c to e are repeated.

G. The release time for the next inlet downstream is set equal to the minimum release time from the default file and steps A - F are repeated. This results in all reaches downstream of the reach for which the release time was entered being recalculated.

Entering **CONDUIT SIZE** on screen 7 causes the following calculations to occur.

A. The size entered is checked against the available conduit sizes in the default file for the conduit type entered on screen 7.

B. The conduit capacity is determined using the following procedures based on inflow control type.

1. CONDUIT CONTROL.

Conduit control will be displayed if no orifice depth was entered for the inlet on screen 5.

a. The next control point is determined. The control point may be the next inlet, junction, or the outlet.

b. The conduit capacity to the next control point is calculated using equation 17. K_m is set equal to the default file K_e (entrance loss coefficient). K_p is determined using equation 18 and the default file Manning's n value. L is set equal to the distance to the next control point.

If the next control point is an inlet, H is set equal to the difference between the two inlet elevations.

If the next control point is a junction, H is set equal to the inlet elevation plus the default file assumed pool depth minus the conduit gradeline at the junction.

If the next control point is the outlet, H is set equal to the inlet elevation plus the default file assumed pool depth minus the outlet elevation or tailwater elevation.

c. The conduit size, required capacity and conduit capacity for all reaches up to the next control

point are set equal to the values for the current reach.

2. ORIFICE CONTROL

Orifice control will be displayed if an orifice depth was entered for the inlet on screen 5.

a. The next control point is determined. The control point may be the next inlet, junction, or the outlet.

b. The conduit capacity of the reach is calculated using equation 17. K_m is set equal to 0. K_p is determined using equation 18 and the default file Manning's n value. L is set equal to the reach length.

If the next reach is not a control point, H is set equal to the conduit grade times L.

If the next reach is an inlet control point with orifice inflow control, H is set equal to the conduit grade times L.

If the next reach is an inlet control point with conduit inflow control, H is set equal to the start of the reach conduit gradeline elevation minus the inlet elevation plus the default file assumed pool depth.

If the next reach is a junction control point, H is set equal to the conduit grade times L.

If the end of the reach is the outlet, H is set equal to the start of the reach conduit gradeline elevation minus the outlet elevation or tailwater elevation.

c. If the next reach is not the next control point, the reach number is incremented and step b is repeated.

C. The release rate is set equal to the conduit capacity minus the upstream reach capacity.

D. The release rate is checked against the default file minimum discharge times the inlet watershed area.

E. The release time is calculated using equation 23.

F. The release time is checked against the default file minimum release time.

G. The required conduit capacity is set equal to the actual conduit capacity.

H. The required pool floodwater storage volume is calculated using the volume calculation procedure selected in the Change Default Data program (screen 10).

If procedure 1 was selected, equation 1 is used with the appropriate runoff volume from screen 3.

If procedure 2 was chosen, the storage volume is determined by multiplying the appropriate watershed area and runoff volume on screen 3.

If procedure 3 was selected, storage volume is determined by multiplying the appropriate watershed on screen 3 with the fixed runoff depth.

I. The release time for the next inlet downstream is set equal to the minimum release time and the procedures for release time entered are followed. This results in all reaches downstream of the reach for which the conduit size was entered being recalculated.

SCREEN 10

DESIGN PEAK (CFS)

The reach design flow rate is determined using the following procedure.

A. The watershed area up to the downstream end of the channel reach is calculated by overlaying the screen 3 outlet reach over the screen 10 channel reaches. The appropriate outlet watershed area is apportioned to the channel reaches.

B. The runoff depth at the downstream end of each reach is determined by overlaying the screen 3 outlet reach over the screen 10 channel reaches. The appropriate outlet runoff volume (acre-ft) is apportioned to the channel reaches. The runoff volume is converted to runoff depth (in) by dividing the runoff volume by the watershed area times a conversion factor.

C. The time of concentration at the end of each reach is determined by using equation 4.

The travel time for the channel flow segment is calculated using equation 3 and assuming a flow velocity of 2 fps and a travel length equal to the distance from one upstream end of the channel to the downstream end of the reach.

The sheet flow length is determined by dividing the reach watershed area by the channel length from the upstream end of the channel to the downstream end of the reach.

The travel time for up to 300 feet of flow is determined using equation 5. The travel time for the portion of sheet flow greater than 300 feet is calculated using equation 6.

D. The peak flow rate is calculated using equation 11 using the time of concentration calculated in step 0, the runoff depth calculated in step 0, and the watershed area calculated in step 0.

The coefficients used in equation 11 are determined using the runoff curve number on screen 2 which applies to the channel reach being considered.

MAXIMUM ALLOWABLE VELOCITY (FPS)

The maximum allowable velocity is selected from the default file (screen 9 in the Change Default Data program) based on the lining type and erosion resistance values entered.

STABILITY VELOCITY (FPS)

The stability velocity is determined using the following procedures.

A. The channel bottom width and side slope ratios are determined from the appropriate x-section information on screen 8.

If the design x-section slope widths are specified instead of the slope ratios, the slope ratios are calculated by assuming a 1 foot channel depth.

B. A trial stability velocity of 3.5 fps is assumed.

C. A trial stability area is calculated using equation 14.

D. A trial stability depth is calculated using equation 12.

E. A trial stability hydraulic radius is calculated using equation 13.

F. If the channel lining is bare earth, the trial stability Manning's n value is set equal to the stability n value in the default file (screen 9 in Change Default Data program).

   If the channel lining is grass, a trial stability Manning's n value is calculated using equation 16 and the stability CI value from the default file (screen 9 in Change Default Data program).

G. The actual stability velocity is calculated using the trial stability hydraulic radius and trial stability n value using equation 15.

H. The trial stability velocity and actual stability velocity are compared. If the values are not within 0.001 fps, a new trial velocity is calculated based on the formula $V_{T\ new} = (V_{T\ old} + V_{actual})/2$ and the process is repeated starting with step 0.

CAPACITY DEPTH (FT)

The channel capacity flow depth is determined using the following procedures.

A. A trial capacity depth of 1.0 foot is assumed.

B. A trial capacity area is calculated using equation 14.

C. A trial hydraulic radius is calculated using equation 13 and the channel bottom width and side slope ratios of step 0 of the stability velocity calculations.

D. If the channel lining is bare earth, the trial capacity Manning's n value is set equal to the capacity n value in the default file (screen 9 in Change Default Data program).

   If the channel lining is grass, a trial capacity Manning's n value is calculated using equation 16 and the capacity CI value from the default file (screen 9 of Change Default Data program).

E. The actual capacity velocity is calculated using the trial capacity hydraulic radius and trial capacity n value using equation 15.

F. The trial capacity velocity and actual capacity velocity are compared. If the values are not within 0.001 fps, a new trial capacity depth is calculated based on the formula $D_{T\ new} = (V_{trial} * D_{T\ old})/V_{actual}$ and the process is repeated starting with step 0.

SCREEN 11

CUT/FILL BALANCE METHOD

Pool depth, pool volume, cut volume, fill volume, borrow volume, and spoil volume are calculated when a cut/fill balance method is entered based on the balance method and outlet type.

A. The following procedure is followed for all cut/fill balance based on the outlet type entered on screen 4.

   1. UNDERGROUND OUTLET

      a. The required pool sediment storage volume is calculated using equation 21. The S_{loss} is

determined by overlaying the screen 2 soil loss (tons/acre) values over the pool reach and calculating a weighted average. The remaining factors needed in equation 21 are determined from the default file (screen 7).

b. The required pool storage volume is calculated by adding the pool sediment storage volume and the pool floodwater storage volume calculated on screen 7.

c. The pool depth which gives a pool storage volume within -5% to +10% is calculated.

d. The design ridge elevation is calculated at each ground x-section point. The design ridge elevation is set equal to the channel gradeline elevation plus the default file minimum design height or the channel gradeline elevation plus the appropriate channel capacity flow depth from screen 10 or the inlet elevation plus the pool depth, whichever is highest.

e. The design x-section at each ground x-section is calculated using the appropriate x-section shapes from screen 8 and the ridge and channel elevations.

f. The cut area and fill areas are calculated for each x-section.

g. The cut volume and fill volumes are calculated using the x-section areas and the average end areas. If no x-section exists at the start or end of a design reach, the nearest x-section areas are used. If a x-section is shared by two design reaches (such as when a x-section occurs at a watershed break), the x-section will only be used in calculations with the design reach with the lower stationing.

h. Borrow or spoil volume is calculated by determining the volume of available fill using equation 25.

If the volume of available fill is less than the volume of fill, borrow is required and the borrow volume is calculated using equation 26.

If the volume of available fill is greater than the volume of fill, spoil is available and the spoil volume is calculated using equation 27.

If the volume of available fill equals the volume of fill, spoil volume and borrow volume are set to 0.

2. GRASSED WATERWAY

Steps d to h above for UNDERGROUND OUTLETS are used.

3. INFILTRATION

Steps a to h above for UNDERGROUND OUTLETS are used.

4. STRUCTURE

Steps d to h above for UNDERGROUND OUTLETS are used.

B. If the cut/fill balance method is **1 - NONE**, the design is complete.

C. If the cut/fill balance method is **2 - CHANNEL ELEV** and the spill volume is greater than the cut volume times 0.05 or the borrow volume is greater than the fill volume times 0.05, the channel gradeline is raised or lowered. The channel gradeline is raised or lowered by determining an incremental depth which is added to the start and end elevations of all the gradeline reaches except those occurring at watershed break stations. Step A is then repeated. If the earthwork is not balanced after 20 repetitions of step A, the balancing process is stopped.

D. If the cut/fill balance method is **3 - BCSW @ EACH X-SEC**, the cut and fill areas are balanced at each x-section. The required cut area is determined by dividing the fill area by the cut/fill density ratio. If the cut area is not within 2% of the required cut area, the back cut slope width is incremented and the x-section recalculated. If the new back cut slope width equals 0 or the number of balance tries is greater than 20, the balancing process is stopped for the x-section being balanced.

E. If the cut/fill balance method is **4 - BCSW @ SELECT X-SEC** and spoil volume is greater than the cut volume times 0.05 or the borrow volume is greater than the fill volume times 0.05, the back cut slope width of selected x-sections is changed. The x-sections changed and the amount of change is determined by the back slope height from the ridge centerline to the back slope toe. The minimum back slope height for the design reach is determined. The minimum back slope height required is determined by adding an incremental height based on the spoil and borrow volumes. Each x-section is checked to see if the back slope height is less than the required back slope height. If it is, the back slope width is incremented until the height equals the minimum required height. The earthwork volumes are then recalculated. The process is repeated for a maximum of 20 times.